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EDITORIAL

THE FUTURE

WE write this during the heat of midsummer. Personally, we agree with an editorial writer who, in a metropolitan daily, urged the congress to close out its business, and all hands to pause and take a breathing spell and do nothing for awhile. We would like to rest on our oars, but before we know it the trees will be bare of leaves, winter ice and snows will block the doorway, and distant spring will be not far behind. Shortly after this appears, medical schools will begin another year and wondering freshmen will enter classes and dissecting-rooms. Vacations over, the great majority of the profession will be back in harness, reading the July and August journals they had put aside, getting their offspring off to school and college, and dreaming of the mid-winter or next summer's trip.

Editorially, we must keep about six months ahead of the seasons. Therefore, months ago we were happy to receive a note telling us that Dr. Hugh Cabot of the Mayo Clinic would be Guest Editor of our urological number which will appear next month. Dr. Cabot has done a splendid bit of work, and the articles he has arranged by outstanding men from this country and abroad will prove worth while to the general surgeon as well as the urologist. But the final verdict will rest with the readers, and of their favorable opinion we have no doubt. Dr. William E. Ladd, of Boston, has arranged a select collection of papers on Surgery in Children. He sidestepped the usual pitfall—that of including every conceivable condition in the surgical bracket—and has included only those topics of the widest interest.

The surgeon and the general practitioner treats fractures. Dr. Kellog Speed of Chicago will be Guest Editor of a fracture number. All common fractures will be dealt with and, especially, the mode of treatment for each. We will be disappointed if this does not prove an outstanding and most valuable issue.

The year will close with a number devoted to the stomach, pancreas, liver and gall-bladder. Dr. Frederick A. Coller, Professor of Surgery at the University of Michigan, is arranging this issue.

We recite these facts to let our subscribers know that between now and another summer four important and worth while special numbers of the Journal will be published. In addition, we have on hand excellent original papers and case-reports for the other numbers. Dr. Falk's installments, "Practical Clinical Gynecology," will continue to appear.

But we now come to what we had in mind when we started this hot weather chat. Our plans are completed for this year, but next year will be here before we realize it and we must begin thinking and planning things for when that time rolls around. We are eager for suggestions. Between October, 1938, and May, 1939, we hope to publish four more special numbers.

Have you any preferences, or ideas as to what topics you desire covered?

In a vague way we have been playing with the idea of a number devoted to the large intestine, rectum and anus; one to the neck; one to the feet and hands; and one to differential diagnosis of surgical conditions. All are in a nebulous state at this writing.

If we receive ideas we'll try to start the wheels and turn those ideas into realities.

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ORIGINAL ARTICLES

HYPERTHYROIDISM IN CHILDREN UNDER FIVE YEARS OF AGE

REPORT OF FOUR CASES

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HYPERTHYROIDISM is not often seen in childhood, and its occurrence in children under five years of age is so rare that it is almost a medical curiosity. In a previous communication[1] the English literature on hyperthyroidism in children has been reviewed and can be summarized by the statement that in children under five years of age, only seven cases of clear-cut hyperthyroidism have been subjected to adequate diagnostic studies and fully reported. These cases with the age and sex of the child and the name of the author who reported them are shown in Table 1.

TABLE 1

CASES OF PROVED HYPERTHYROIDISM IN CHILDREN UNDER 5 YEARS OF AGE REPORTED IN THE ENGLISH LITERATURE

Author	Age	Sex	Treatment	Outcome
Helmholtz	3	M	Thyroidectomy	Cure
Braid and Neale	2½	F	Thyroidectomy	Operative death
Lahey	3	not stated	Thyroidectomy	Cure
Stephen	2	F	Conservative	Cure
Beilby and Carlton	2¾	F	Thyroidectomy	Cure
Kerley	3½	F	Conservative	Cure
Elliot	2½	F	Thyroidectomy	Cure

[1] CRILE, GEORGE, JR. and BLANTON, J. LEWIS. Exophthalmic goiter in a male child two and one-half years of age. *Am. J. Dis. Child.*, 53: 1039–1046 (April) 1937.

In a series of 26,682 cases of thyroid disease which have been seen at the Cleveland Clinic, the following 4 occurred in children less than 5 years of age, an incidence of one in 6670 cases.

CASE 1. The patient was a girl 4 years and 3 months of age (Fig. 1). The parents stated that prominence of the eyes had been noted at the age of two and one-half years and had remained unchanged until eight months before entry at which time the tonsils were removed. Following this procedure the eyes appeared to recede. Fullness of the neck, excitability and irritability were also noted. During the year before entry Lugol's solution, in doses of one minim daily, was given and improvement was noted following this treatment. On several occasions when iodine was withdrawn for more than a week, it was noticed that the symptoms became worse. In the preceding eight months, although the patient had grown one inch in height, she had lost one pound of weight. It is interesting that the mother of the patient had a goiter, a maternal aunt had hyperthyroidism, and a maternal uncle had a goiter and had always been nervous. The mother took iodides for a time during her pregnancy.

Physical examination showed the pulse rate to be 120. The systolic blood pressure in millimeters of mercury was 100 and the diastolic, 5. There was a diffuse, solid enlargement of both lobes of the thyroid gland but no thrill or bruit could be made out. The heart was slightly enlarged to the left and there was a systolic murmur at the apex. A digital tremor was present and the skin was warm and moist.

Inasmuch as the patient was improving she was advised to rest for two months and if sufficient progress had not been made at the

Fig. 1. Case 1. Photograph of patient before operation.

end of this time, to have a thyroidectomy. From this point on, the patient was under the care of Dr. DeWitt Sherman of Buffalo, New York, who states that her condition continued to improve with rest and small doses of iodine but that the family moved away and he has had no further reports of her progress.

Case II. The patient was a girl 4½ years of age. Two months before entry her mother had been told that the child had a goiter and believed that the neck had enlarged a little since this time. She had been taking small doses of iodine. The only symptoms were fatigue, nervousness and irritability and the appetite was not very good. In addition, the parents had noticed that she had been masturbating. There had been no weight loss and no fever. The past history was entirely negative except for a tonsillectomy at the age of one year. There was no family history of goiter.

The weight was 39½ pounds, the height forty-three inches. Physical examination showed prominence of the eyes and a diffuse, smooth, firm enlargement of the thyroid gland to about three times its normal size. The pulse rate was 130, and the blood pressure in millimeters of mercury was 125 systolic, 0 diastolic. The heart was not enlarged but the apex impulse was forceful; the sounds were regular and of good quality.

A diagnosis of diffuse goiter with hyperthyroidism was made, and the patient was advised to take small doses of iodine (10 mg.) every second day and return in one month. In addition four minims of elixir of sodium bromide three times daily were prescribed.

One month later the pulse rate was still 130 and the patient weighed forty pounds, a gain of one-half pound. The parents stated that she had improved strikingly on iodine and bromides for the first two weeks, but that diarrhea developed and the medicine was discontinued. The eyes were definitely more prominent, and the thyroid gland seemed larger. The child was very nervous. The dosage of iodine was increased to two minims of Lugol's solution three times daily, and the patient was instructed to return in one month. At the end of this time she had gained two pounds, but was more nervous and active. A marked digital tremor and a definite staring expression and lid lag were present.

At this time the eyes in the anteroposterior position measured 19 mm. and 18 mm. respectively and the palpebral fissures measured 12 mm. each. There was definite weakness of the muscles of accommodation and convergence. A determination of the basal metabolic rate, which was not satisfactory because of lack of cooperation, showed plus 32 per cent. Examination of the blood and urine revealed no abnormalities. The blood sugar was normal and the Wassermann and Kahn reactions were negative. A roentgenogram of the chest showed a rather large heart, the left auricle being especially enlarged.

In view of the steady progression of the disease, thyroidectomy was advised. The patient was admitted to the hospital, was kept in bed, and was given five minims of Lugol's solution and ten grains of sodium bromide three times daily. The pulse rate which was 180 at entry failed to fall in response to this therapy and at the end of twelve days still varied between 120 and 150. A subtotal thyroidectomy was then performed under local anesthesia supplemented with avertin in a dose of 80 mg. per kilogram of body weight, and gas oxygen analgesia. Fifteen grams of thyroid tissue was removed and the pathological diagnosis was "goiter, hyperplastic, slight and involuting." A little more

than the usual amount of thyroid tissue was left in order to maintain the normal thyroid balance during the growth period. Operation was followed by a minimal reaction, the maximum temperature being 101.5°F. and the pulse rate rising only to 160. The patient was discharged on the tenth postoperative day. Her pulse rate at that time was 120.

Three months after operation, it was found that definite exophthalmos had occurred (Fig. 2). The right eye measured 20 mm. in the anteroposterior position and the left eye 19 mm. The palpebral fissures were widened and measured 17 mm. The child had gained four and three-fourths pounds since operation but was still very nervous and restless. The pulse rate was 134. Convalescence had been retarded by the development of chicken pox and following this the child had not appeared to progress very well.

A diagnosis of residual hyperthyroidism was made and small doses of Lugol's solution were again prescribed. The child continued to masturbate a great deal of the time and this habit no doubt contributed to the nervousness. The teeth showed marked caries. In view of the rapidly progressive exophthalmos, it was decided to explore the neck again, and 10 grams of thyroid tissue were removed from the right lobe. The pathological report was again "goiter, hyperplastic, moderate involuting."

The basal metabolic rate at this time was only plus 13 per cent, and in spite of the fact that a great deal of thyroid tissue had been removed at the first operation, symptoms of residual sympathetic nervous system instability persisted; therefore it was decided to stabilize the sympathetic system further by performing a left adrenal denervation. A satisfactory denervation of the adrenal gland was obtained five days after the thyroidectomy. Following these procedures the pulse rate fell to 85 and remained at that level. The exophthalmos, however, increased progressively and six months later the left eye measured 22 mm. in the anteroposterior position and the right 24 mm., the fissures measuring 17 and 18 mm. respectively.

Twenty-one months after the child was first seen and fifteen months after the last operation, the eyes had receded to 22.5 mm. in the anteroposterior position. The pulse rate varied from 80 to 98 and the child weighed 47½ pounds and was apparently developing normally in every respect.

Case III. The patient was a child 4 years of age. When she was about three years of age, the parents had noticed that the pulse was abnormally fast. Approximately seven months before entry it was noticed that the thyroid gland was enlarged and about the same time the eyes became prominent. A diagnosis of hyperthyroidism was made at this time and roentgenotherapy was used twice over the thymus and six more times over the thyroid gland. In the six months preceding this examination one minim of Lugol's solution had been taken twice daily. The parents stated that the child was nervous, irritable, cried easily, and had not gained in weight recently. It is interesting to note that the patient's maternal uncle had had exophthalmic goiter.

Fig. 2. Case II. Photograph of patient shortly after operation. Note persistent exophthalmos.

The child's weight was 37 pounds and she was very nervous and excitable. The thyroid gland was diffusely enlarged and rather soft; marked exophthalmos was present (Fig. 3). The pulse rate was 160, the apex impulse was forceful, and there was a loud systolic murmur over the entire precordium.

The patient was admitted to the hospital where she was kept in bed for ten days and was given three-fourths of a grain of luminal

Fig. 3. Case III. Photograph of patient before operation.

daily and two minims of Lugol's solution three times daily. At the end of this time, her pulse rate was still consistently between 140 and 160.

Bilateral ligations of the superior thyroid arteries were performed under gas oxygen anesthesia. The improvement following this procedure was striking, the pulse rate falling to 135 by the eighth postoperative day. A left lobectomy was then performed and although the pulse rate rose to 190 beats per minute on the second night after operation, the maximum postoperative temperature was 101.6°F., and the condition was never critical. She was discharged from the hospital on the seventh postoperative day, the pulse rate still averaging 140.

The pathological report of the tissue excised was moderate hyperplasia of the thyroid gland.

Four months later the patient returned and she was much improved in every way. The pulse rate was 130 at that time.

The final lobectomy was performed with a minimum postoperative reaction and the patient was discharged on the twentieth postoperative day with a pulse rate of 90 to 100. Convalescence was complicated by the development of a transitory tetany which soon cleared.

Eighteen months after the final lobectomy, the patient was readmitted to the hospital for tonsillectomy. At that time her pulse rate varied between 85 to 100 and the basal metabolic rate was plus 4 per cent. Her development appeared to be normal in every respect.

Case IV.* The patient, a boy 2½ years of age, was referred to the Clinic by Dr. J. Lewis Blanton who had made a diagnosis of diffuse goiter with hyperthyroidism. The onset of the hyperthyroidism had been rapid and at the time of entry to the hospital the child was crying continuously and appeared to be on the verge of a thyroid crisis (Fig. 4). Exophthalmos was present. There was a diffuse enlargement of the thyroid gland, a persistent, forceful tachycardia, a pulse rate of 160, muscular weakness, and a low blood cholesterol.

After twelve days of bed rest during which four minims of Lugol's solution and five grains of sodium bromide were given three times daily, subtotal thyroidectomy was performed under local anesthesia supplemented with 100 mg. of avertin per kilogram of body weight. Operation was followed by a moderately severe reaction during which the pulse rate rose to 170 and the temperature to 105°F. An acute follicular tonsillitis complicated the convalescence, but the child made an uneventful recovery. Several months after operation, Dr. Blanton reported that the patient was gaining weight, was less nervous, and was improving in every way.

DISCUSSION

As a rule the hyperthyroidism of children is typical exophthalmic goiter in which all the classical signs are present. Enlargement of the thyroid gland and exophthalmos are quite constant findings and the diagnosis can usually be made at a glance. Table II taken from Dinsmore[2] and Helmholtz's studies shows the relative incidence of the classical symptoms in children.

It is apparent that exophthalmos is much more common in the hyperthyroidism of children than in that of adults. For this reason, the eyes should be one of our chief concerns in the management of the child

* Detailed study of this case report appeared in *Am. J. Dis. Child.*, 53: 1039–1046, 1937.

[2] Dinsmore, Robert, S. Hyperthyroidism in children; a review of fifty-seven cases. *J. A. M. A.*, 99: 636–638, 1932.

with hyperthyroidism. In all four cases reported here, exophthalmos was present and in the second case severe exophthalmos developed during the time the child was under treatment. This exophthalmos, as is so often the case, has not as yet receded to normal and will doubtless be a cause of considerable difficulty in later life if the patient's occupation requires much close work with the eyes.

TABLE II

COMPARISON OF FREQUENCY OF SYMPTOMS IN HELMHOLZ'S CASES AND THOSE IN CASES FROM THE CLEVELAND CLINIC AS REPORTED BY DINSMORE[2]

	Helmholz, 40 Cases, Per Cent	Cleveland Clinic, 57 Cases (Dinsmore), Per Cent
Tachycardia	100	100
Nervousness	93	91
Thyroid enlargement	93	93
Exophthalmos	83	76
Bruit	70	49
Hyperhidrosis	67	55
Tremor	57	66
Loss of weight	53	50
Polyphagia	50	40
Weakness in quadriceps	47	
General weakness	...	58
Gastrointestinal symptoms	47	43
Dyspnea	40	55

Since exophthalmos occurs so frequently in children, since its development may represent an irreversible change, and since early and adequate operation usually prevents the development of marked exophthalmos, it is extremely important to make accurate measurements of the position of the eyes if conservative management of hyperthyroidism in a child is to be tried. At the first definite indication of the development of progressive exophthalmos, subtotal thyroidectomy should be performed.

Although our experience with conservative therapy has not been satisfactory and we have rarely been able to control the disease without operation, in mild or early cases when the patient can be kept under close observation, conservative measures can safely be given a trial. If conservative therapy is selected, focal infection should be eliminated, bed rest should be prescribed, and small doses of iodine and bromides given. But since hyperthyroidism in a child differs in no way from exophthalmic goiter in an adult, and the risk of operation is no greater than in hyperthyroidism of equal severity in an adult, and since protracted conservative therapy entails loss of opportunities in both educational and physical development at a period in the child's life when these opportunities are most needed, we can see no reason for prolonged delay of an operation which in all probability will eventually be necessary.

FIG. 4. Case IV. Photograph of patient before operation. Patient was crying and the exophthalmos therefore, is not apparent in the photograph.

The mortality rate from operations on children with exophthalmic goiter has not been high. In the Cleveland Clinic series only 2 deaths occurred in a series of 54 cases of hyperthyroidism in children under fourteen years of age. Since 1925 iodine has been used routinely in preparing patients with hyperthyroidism for operation and since this time there have been no fatalities in a series of forty thyroidectomies for hyperthyroidism in children.

If the patient is adequately prepared for operation and if the postoperative course is carefully managed, there is no reason why thyroidectomy should entail any greater risk in children than in adults. The same principles of management should apply in dealing with children as in adults. The procedure should be carried out as much as possible under local anesthesia with enough basal anesthesia and gas oxygen analgesia to render the patient cooperative and quiet. After the operation, an adequate carbohydrate intake should be assured and glucose should be given if necessary. In severe cases, it is advisable to administer a solution of 10 per cent glucose by means of a continuous intravenous drip.

In normal children the metabolism per unit of body weight is high as compared with adults, and in children with exophthalmic goiter it is extremely high. Children, therefore, tolerate large doses of sedative drugs without much depression. In Case IV, that of a 2½ year old boy, there was no depression of respiration after hypodermic injections of one-eighth grain of morphine sulphate. Calculated according to weight, this dose would be the equivalent of five-eighths of a grain of morphia in an adult. It is important to remember that children with high metabolic rates oxidize and detoxify drugs with great rapidity and that the usual dosages must be increased if the full therapeutic effect is to be obtained.

Morphia is the most valuable sedative in the postoperative management of patients with hyperthyroidism. Children cannot rationalize or cooperate enough to remain quiet voluntarily, and it is here that morphia is of value in giving the rest and sedation which are so essential if the postoperative reaction is to be minimized. Any hesitancy in the administration of relatively large doses of morphia to children should be overcome and the morphia should be given not in doses calculated on body weight, but in accordance with the physiological reaction obtained.

Avertin, in doses of 60 to 100 mg. per kilogram of body weight, has given satisfactory basal anesthesia in operations for exophthalmic goiter in children. Before the introduction of this drug, operations were performed under gas oxygen anesthesia (as in Case III) and induction was rendered quiet and easy by the anesthetist making daily visits to the child's room and giving her oxygen inhalations to accustom her to the gas machine. Ligations and thyroidectomy were performed in this way without arousing the suspicion of the patient or having her associate the presence of the gas machine with the postoperative discomfort.

Children with hyperthyroidism require relatively larger doses of avertin in order to obtain a given sedative effect. The 2½ old boy (Case IV) dozed for forty-five minutes after a dose of 100 mg. avertin per kilogram of body weight and at the end of this time was asking for candy.

The three most common causes of death following operations for hyperthyroidism are (1) pneumonia, (2) cardiac failure, and (3) thyroid crisis. In children there is little danger of postoperative pneumonia; the myocardium is not affected as is so frequently the case in elderly patients, and auricular fibrillation and cardiac failure are rare complications. In none of the three cases of severe hyperthyroidism reported here did any cardiac arrhythmia occur after operation. The chief danger following operation in children is the development of a thyroid crisis with its attendant vicious circle of hyperthermia and hypermetabolism. This complication did not occur in this series, but in Case IV the temperature rose to 105°F. and the pulse rate to 170. Although the development of acute follicular tonsillitis increased the severity of the postoperative reaction, the patient's condition was never critical. Five grains of aspirin always resulted in defervescence to a level two or three degrees F. lower than before the medication was given, and the oxygen tent afforded comfort and rest.

Since the susceptibility to postoperative pneumonia is not as marked in children as

in older people, since the myocardium is stronger in children, and since a thyroid crisis can usually be modified or averted by the parenteral administration of glucose solution, by adequate sedation with morphia, and by use of the oxygen tent, there is little reason to feel that thyroidectomy for hyperthyroidism is more dangerous in a child than in an adult. In the early days before iodine was used in the preoperative preparation of patients with hyperthyroidism, it was often necessary to remove the gland in stages or to perform preliminary ligations of the superior thyroid arteries. In recent years however, we have been performing more and more one stage operations on children and have not as yet seen any reason to change our belief that the child is an excellent surgical risk.

SUMMARY

1. Four cases of exophthalmic goiter in children under five years of age are reported. All patients recovered, three after thyroidectomy and one after conservative therapy.

2. Hyperthyroidism in children is no different from exophthalmic goiter in the adult and thyroidectomy is the treatment of choice.

3. If it is decided to treat a mild or early case of hyperthyroidism conservatively, it is important to have accurate measurements of the extent of exophthalmos and to advise prompt thyroidectomy if the exophthalmos progresses.

4. Thyroidectomy presents no greater hazard in a child than in an adult. No fatalities have occurred in the last forty thyroidectomies which have been performed for hyperthyroidism in children under fourteen years of age.

5. Since children are excellent operative risks, one-stage thyroidectomy can usually be performed without danger.

SUBCUTANEOUS FIXATION WITH SCREWS FOR FRACTURES OF THE HIP

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THE treatment of fractures in the neck of the femur has always been a difficult problem, and the results have been so unsatisfactory that recently various new methods have been devised to reduce the high mortality and prevent non-union. Past reports from various clinics have shown an average mortality rate of 20 per cent, with non-union occurring in approximately 33 per cent of those patients who survived. In small institutions and under less favorable circumstances, the death rate and frequency of non-union have been undoubtedly higher.

FIG. 1. Reduction is completed by internal rotation, after which both limbs are held by assistants.

Although advanced age and debility are contributing factors, non-union in these fractures is mainly due to the scanty blood supply, lack of reduction and incomplete immobilization. As most of the circulation to the head and neck of the femur is derived from the trochanteric area, a break in the continuity of the neck leaves the head virtually without nourishment. Considering this deficiency of blood supply, and the absorption, or "aseptic necrosis," which may occur during any form of treatment, it is obvious that such fractures heal slowly even under the most favorable circumstances.

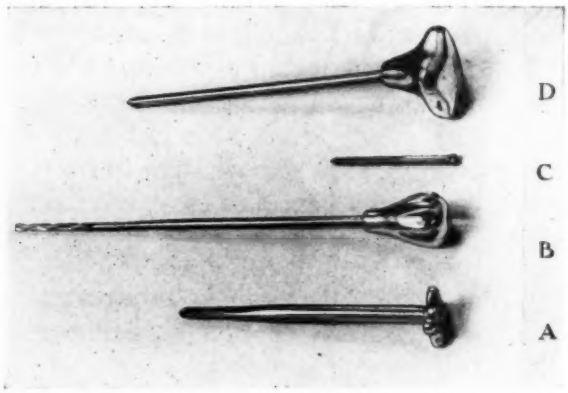

FIG. 2. Instruments for subcutaneous fixation devised by the author: A, split cannula; B, drill; C, modified carpenter's screw; D, screw driver.

The first great advance in treatment was made by Whitman, who emphasized the role of internal rotation and abduction in the reduction of these fractures. Later, Leadbetter demonstrated the importance of overcoming posterior displacement of the distal fragment by upward traction upon the hip. Even after reduction, the common practice of immobilizing fractures of the hip by a plaster spica has not been found satisfactory in many respects. Absolute immobilization of the fragments is lacking because there is movement of the atrophied limb inside the plaster spica. Furthermore, the distal fragment tends to gravitate posteriorly on account of the softening which occurs in the opposing edges of the fracture. Finally, if the aged patient survives the long period of confinement to bed with plaster, the result in a large proportion of cases is permanent disability from non-union.

Most of the difficulties encountered in the use of external immobilization and the

resulting weakness from prolonged inactivity have been overcome by various forms of internal fixation recently devised, which immobilize the fragments while permitting early function. This form of treatment requires only a short period in bed, and convalescent care is simplified. Complications are thus avoided, the aged are saved from invalidism, and the function of joints is preserved. The following recent statistics for fractures in the neck of the femur indicate that internal fixation

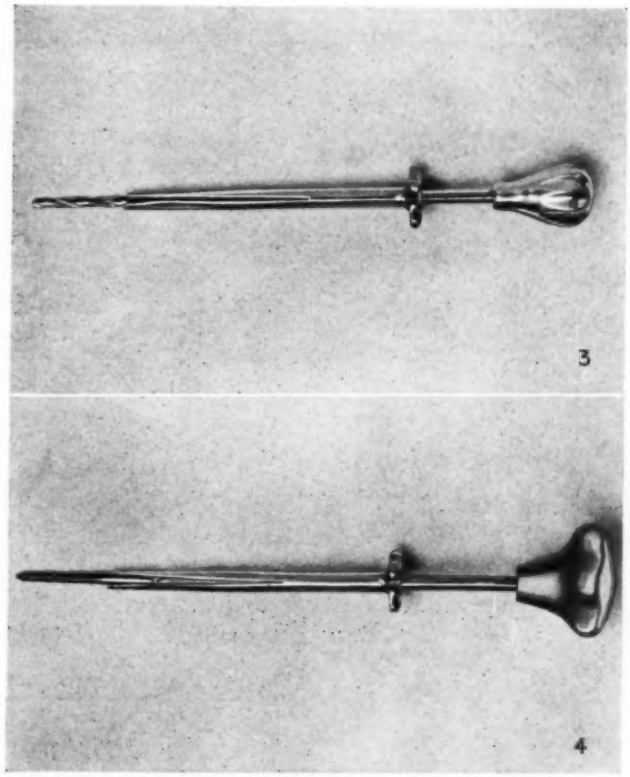

Fig. 3. Drill in cannula. The cannula is made of tempered steel. Its end opens as the drill advances.
Fig. 4. Screw and screw driver, guided and held together by the cannula.

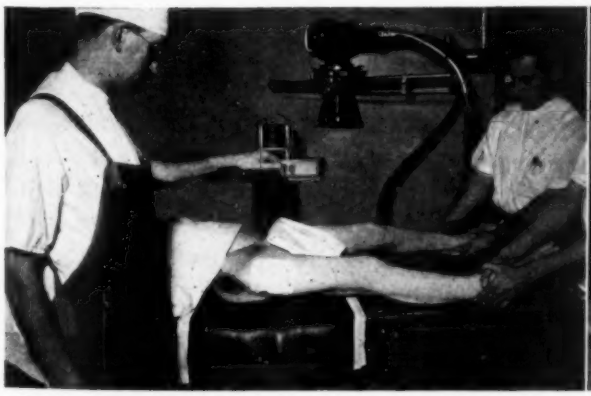

Fig. 5. Fluoroscopic examination of the hip. The surgeon is protected from the Roentgen rays by a fluoroscopic apron and by fastening a piece of leaded rubber or sheet lead to the edge of the fluoroscopic table with adhesive tape.

Fig. 6. Draping and instrument table used for subcutaneous fixation. On the table, in the order to be used, are small scalpel, split cannula, drill, two screws, screw driver, forceps and Michel clips.

is the most acceptable form of treatment. Smith-Petersen obtained bony union in 73 per cent of fifty cases; R. Watson-Jones in 85 per cent of sixty-four cases; Martin and Brewster in 90 per cent of fifty-three cases.* Notwithstanding the operative procedure, the mortality rate from this fracture has been greatly reduced.

After a consideration of the different forms of treatment advocated for this fracture, the following statements can be made:

1. For fractures in the neck of the femur the most important factors in obtaining union are reduction and complete fixation of the fragments.

2. These fractures should be reduced by the Whitman-Leadbetter method.

3. External immobilization by plaster is inadequate, as it does not control the fragments; furthermore, this treatment requires prolonged confinement to bed.

FIG. 7.

FIG. 8.

FIG. 7. Insertion of cannula under guidance of the fluoroscope. The cannula, which must be held horizontally, is thrust upward through a stab wound in the skin until it reaches the mid-lateral aspect of the femur, just below the greater trochanter.

FIG. 8. Insertion of drill through the cannula, under guidance of the fluoroscope. The cannula is held horizontally while the distal fragment is drilled, the hole being made in a line with the neck of the femur.

4. Internal fixation completely immobilizes the fragments and offers the best expectancy for recovery, while providing easy convalescence without encumbrance.

Although many types of internal fixation have been reported, the triple-flanged nail devised by Smith-Petersen and the use of two carpenter's screws as advocated by Martin appear to be the most practical. These operations require exposure of the femur, general anesthesia, and the use of portable *x*-rays in the operating room. In order to minimize the operative dangers, to avoid waiting for *x*-rays, and to insure accuracy of fixation, the writer has modified Martin's operation by driving in the screws subcutaneously under guidance of the fluoroscope. This new method is comparatively simple and safe, and can

* These figures apply only to fractures in the neck of the femur. A number of other surgeons have reported excellent results with internal fixation in series composed of both intracapsular and extracapsular (intertrochanteric) fractures.

be used for the aged and others whose general condition contraindicates an open operation.

The fracture must be completely reduced before any kind of fixation is used. Stereoscopic *x*-ray films are not dependable, an accurate visualization of the fracture being obtained only by views made in both the antero-posterior and lateral planes. These show the distal fragment to be externally rotated, with a varying degree of upward and backward displacement. When facilities for a lateral view are not available, it is practical to assume that the distal fragment is displaced posteriorly.

PRELIMINARY TREATMENT

The patient is given an injection of morphine an hour before being placed upon the fluoroscopic table. General anesthesia should not be used, as this method is carried out under the fluoroscope with the room darkened; however, if the fragments are displaced, nitrous oxide-oxygen may be given during manipulation.* For reduction, the Whitman-Leadbetter method is used. While an assistant steadies the pelvis and the opposite limb, the surgeon first applies upward traction to the flexed hip; then the thigh is simultaneously extended and internally rotated with traction, and finally is abducted. If it is impossible to secure a lateral *x*-ray film, the entire maneuver for reduction is carried out on the probability that the distal fragment is displaced posteriorly. Whether or not reduction is complete should be determined by Leadbetter's "heel-palm" test, for which the operator supports the patient's heel in the palm of his hand. There is satisfactory reduction when the foot remains pointing upward. If the limb rotates externally, manipulation should be repeated.

TECHNIQUE

Assistants stand on each side of the fluoroscopic table, and hold both legs internally rotated and moderately abducted. *It is important that this position of the limbs be maintained.* The surgeon

Fig. 9. After the drill has been removed from the cannula, the screw and screw driver are inserted and the screw directed across the fracture and into the femoral head. The end of the cannula is then shifted ½ inch and a second screw driven through another drill hole. The direction and depth of the screws are determined by fluoroscopic visualization.

should protect himself from the Roentgen rays by a fluoroscopic apron and by fastening a piece of leaded rubber over the edge of the fluoroscopic table. The size of the screws necessary is best determined under the fluoroscope. Although a 3½ inch length is usually found to be satisfactory for this fracture, it is advisable to determine the requirement for the individual case by holding a screw of known length over the neck of the femur. While thus visualizing the hip, the skin over the subtrochanteric area is marked to indicate where the stab wound is to be made. Such a precaution has been found especially valuable in obese patients in whom palpation of the trochanter is difficult. The skin over the lateral aspect of the hip is painted with iodine and draped, only the marked area of the skin surface being exposed. A 1 per cent solution of novocaine is used for anesthesia. With a long needle, a weal is

*Recently both the reduction and fixation of these fractures have been carried out under Pentothal sodium anesthesia given intravenously.

made in the skin and then 5 cc. of the solution is injected under the periosteum. With a small scalpel a quarter inch stab wound

Fig. 10. Voluntary flexion immediately after subcutaneous fixation.

Fig. 11. Excellent control of the limb.

Fig. 12. Transcervical fracture before treatment.

Fig. 13. Same after reduction and internal fixation.

is made through the skin and deep fascia, and the split cannula inserted, its flattened end being kept in the axis of the thigh. The fluoroscopic room is now darkened, with the exception of a small guide light* which enables the operator to see the instrument table. Under fluoroscopic visualization the

* A pocket flash light may be conveniently substituted for the small ceiling light.

cannula is then thrust obliquely upward through the vastus externus muscle until it reaches the subtrochanteric area of the femur. *It is important to find the exact center of the lateral aspect of the bone, which can be determined by moving the end of the cannula forward and backward over the shaft of the femur. It is also important to hold the cannula exactly in the horizontal plane during the entire operation.* The drill is next placed in the cannula and a hole bored obliquely upward through the distal fragment, in a line with the neck of the femur. After removing the drill, a chrome-nickel plated screw of selected length and thickness is placed in the cannula, following which the screw driver is inserted. The screw is driven through the drill-hole and across the inner fragment, its depth and direction being seen through the fluoroscopic screen. The end of the cannula is then shifted a half inch, and again under the guidance of the fluoroscope another hole is drilled and a second screw driven in parallel to the first screw. Finally, the cannula and screw driver are withdrawn and the stab wound is closed with a Michel clip.

Fig. 14. Lateral view, showing complete reduction and secure fixation. Note the Michel clip used to close the stab wound.

FOLLOW-UP TREATMENT

As internal fixation does not require either splints or plaster, the difficulties of nursing are reduced to a minimum. A pillow is placed under the knee and a backrest is used at once, thus preventing hypostatic pneumonia. Sitting on the edge of the bed and in a chair with the hip and knee flexed prevents stiffness, and by this continued activity the patient's strength is preserved. After a short period of hospitalization, during which time instruction with crutches is given, the patient is able to go home, but is warned to avoid bearing any weight upon the affected limb for a full year.

CONCLUSIONS

The advantages of internal fixation for fractures in the neck of the femur can be readily appreciated. This form of treatment has a low mortality and offers a much better expectancy for union; it reduces an otherwise long period of inactivity in bed to a short period of hospitalization followed by convalescence on crutches.

Although no form of treatment has yet been devised which is universally successful, the writer has had such satisfactory results with his operation in sixteen cases that a description of the technique is justified. In this procedure the fragments are fastened by two parallel screws which are introduced subcutaneously and under direct visualization of the fluoroscope. There are virtually no contraindications to this method, and it is believed that the operation can be done satisfactorily with ordinary hospital facilities by the average surgeon. General anesthesia is not neces-

sary, local anesthesia preceded by a hypodermic of morphia being sufficient.

Subcutaneous fixation with screws is not intended as a substitute for certain open operations for internal fixation, but is proposed as a safer and more accurate method for the aged persons, most of whom are poor surgical risks.

At present no final report upon this method can be made, as the value of any form of treatment can be determined only from a large series of cases followed over a long period of time.

Fig. 15. Cervico-trochanteric fracture after internal fixation.

The author is indebted to H. W. Christoph, Inc., for technical assistance in the construction of this instrument.

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THE STATUS OF RESEARCH ON THE INJECTION TREATMENT OF HERNIA

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RECENTLY, while preparing a carefully authenticated history of the injection treatment of hernia, it became necessary to compile an exhaustive bibliography and to read all the available literature of the subject. The bibliography has grown to more than 260 titles, from Bichat's first account of Pierre J. Desault's pioneer use of this method as early as 1795,[2] to the numerous and impressive current reports of successful work and basic research now being widely carried on. Related matter, not specifically on the injection method, added another 140 titles to be covered.

Of course the survey disclosed some historic lessons apparently forgotten and now being laboriously learned over again, but its larger value lay in its emphasis of the contrast between the older approaches to the subject and that which more and more characterizes current work. During the last few years, we have for the first time been doing really basic research with scientific care and thoroughness. The results are beginning to influence our practices helpfully.

The same exhaustive survey has gathered and sorted the material for this outline of the research already done, in progress, or still needing doing. The conclusive results so far found are of course summarized, but with such brevity as to give space for emphasis on work which yet needs to be done. It is hoped that this outline will be more than just suggestive, that it will in fact help to secure a closer and more effective coördination between the various research workers in this rather broad field. Thus it is hoped to save some needless duplication of efforts and to direct inquiry into worthwhile but neglected fields. On the other hand, where repetition is valuable, as in statistical studies of sequelae and end-results, suggestions are offered for securing more comparable and therefore more significant data by means of uniform records.

GENERAL THEORY AND METHOD

To clarify the entire discussion, the general theory and method of the treatment must be briefly stated. Only reducible hernias are properly treated by the injection method, and they must be kept continuously reduced during treatment and for a short time thereafter by means of a properly fitted controlling truss. A series of injections are given by hypodermic needle into the local tissues at intervals of days, shifting the site of injection as the repair of the hernia progresses. Suitable incidental techniques are employed to avoid injection into the cord, blood vessels, peritoneal cavity, etc.

The injectant is today usually a mildly irritant solution designed to stimulate a subacute, aseptic and local inflammatory response, the prelude to the active proliferation of fibroblastic tissue. In a couple of weeks, this matures into fibrous connective tissue which closes the hernial rings and canal by adhesion, constriction and obstruction. Obviously, the tissue growth can be placed more or less as needed and to such amount as is required for radical cure. The method can also be used for preventing threatening hernias before they occur, and recurrences can be largely avoided by follow-up with reinforcing injections when needed.

As the treatment is wholly ambulatory, it saves the costs of hospitalization and the losses of work-time and wages involved in the surgical treatment. Its complications and risks are few and not serious, giving it

a strong appeal to the patient fearful of surgery. It is estimated that upwards of thirty thousand cases are recorded in the literature of the treatment, with the recent and carefully reported results quite consistently and impressively favorable.

THE BASIC PATHOLOGY

It may be quite taken for granted that the injection treatment of hernia has no peculiar basic pathology, that its tissue responses and repair processes are substantially those already familiar to us in the healing of wounds and other reactions to irritants. Experimental work with the injection method to date fully confirms this reasonable assumption and undoubtedly will continue to do so. The fundamental theory behind the treatment may properly be said to have been developed by John Hunter with his "adhesive inflammation" and its exudate, by Theodore Schwann with his cell theory and discovery of fibroblasts, by Julius F. Cohnheim's careful account of the vascular phenomena of inflammation, by Elie Metchnikoff's discovery of phagocytosis, and by all the recent detail work of Carrel and others on the factors, velocity and biochemistry of wound healing. Yet special credit must be given to Joseph H. Warren who, in 1883, first applied to the injection method what was then known of general theory, in so doing setting an example of masterly basic discussion which has hardly since been equaled in this field.[30]

Today, of course we have a more complete and precise understanding of the general processes of inflammation and repair, and we have a substantial beginning of experiments disclosing those same processes following the injection of hernial irritants.

BIOPSIES AND NECROPSIES

Hernial repair by injection, being a wholy subcutaneous process, can be followed in histologic detail only by means of biopsies and necropsies. The production of hernias in experimental animals being impractical, the curative effect of injections cannot be tested on animals. But much valuable work on histologic and gross results can be done on muscular, fascial and other tissues of animal subjects. To overcome purely individual factors, one side can be injected and the other left as control. Occasionally the death from any cause of a former hernia patient treated by injection affords an illuminating human necropsy. Or a surgical operation in the treated area permits a biopsy.

Rice offers a method for securing and utilizing such biopsies more frequently.[22] The patient who wavers in choice between surgery and injections is invited to have an injection or two, with the option of then choosing surgery. If he does elect surgery, his admission to the hospital is timed to yield biopsy and histologic material for any desired interval after injection. By placing the test injections well apart in the tissues and at suitable time-intervals, results of several response ages can be studied in the one subject. Injection of dyes shortly before operation, perhaps with a local anesthetic or a regular hernial injectant, permits studies of infiltration as to its rate, extent and directions; all very useful in developing effective technique.

The gross and histologic results so far reported from such studies, and the further suggested research work which needs doing, may be outlined as follows:

1. *Infiltration.* Infiltration tends to proceed along the fascial planes, and around the inguinal rings and canal walls so as to encompass the spermatic cord.[4,24] Studies are needed to determine the effects of gravity, fiber direction, truss pressure, massage, dosage, etc.

2. *Extent of Reaction.* The extent of the inflammatory and repair reactions to one injection approximates 2 cm. in diameter.[4] Probably this varies with solutions, dosages and infiltration factors yet to be investigated.

3. *Mode of Closure.* Substantial growth of new tissue usually fills the rings and constricts the canal, while adhesions weld

together apposing surfaces firmly. The hernial protrusion is thereby effectively obstructed.[3,4,11,14,22] This result is amply established both clinically and by biopsies, and needs more study only to check results of various techniques.

4. *Fate of the Sac.* Though no efforts are nowadays made to inject the hernial sac itself, it is normally occluded by adhesions from inflammation extending from adjacent parts.[25] Slobe, however, privately reports a dissolved sac with only remnant strands about the internal ring, and with a recurrence resulting.[28] This suggests that the fate of the sac has practical significance and should therefore be studied and fully reported at every opportunity.

5. *Intraperitoneal Injection.* Soon after injection into the peritoneal cavity of animals, firm adhesions form between peritoneum, omentum and the several intestinal loops, without obstruction.[4,6] Wolfe, with doses twenty to thirty times normal (as compared to relative body weights), also found complete obstruction of the intestinal canal by adhesive bands.[32] Accidental injection into the human peritoneum is instantly painful and can readily be avoided in dangerous amounts. Rapid resorption of peritoneal and omental adhesions seems usual and should be studied at intervals of months after intraperitoneal injection.

6. *The Spermatic Cord.* After a few normal injections, the newly formed fibrous tissue makes somewhat more difficult the dissection of the spermatic cord from the surrounding structures.[22] Direct injection into the tough cord integuments is a rare accident. However, repeated injections of a tannic solution into the cord of a dog revealed no gross lesion thirty days later. Several microscopic sections of the testis and cord showed the former normal and the latter perfectly preserved, with a subacute inflammatory reaction in the surrounding structures.[32] Confirming studies are suggested as important.

7. *Mild vs. Strong Irritants.* It is the general experience that overdoses and such strong irritants as phenol and thuja may cause acute inflammation, tissue necrosis and less effective repair, and so are to be avoided.[36] Mild irritants, on the other hand, cause subacute inflammation without pain, with no necrosis, less exudate, fewer phagocytic and scavenging leucocytes (polymorphonuclears and large mononuclears), and more lymphocytes, in whose presence fibroblast tissue proliferates abundantly and then finally matures as the fibrous connective tissue of the effective hernial repair.[4,13,16,18,23,32] Further study should be more specific than heretofore in relation to the several solutions and formulas, their concentrations, dosages and intervals of injection.

8. *Velocity of Repair.* The velocity of repair following one injection is found to approximate that of wound healing by first intention, with the usual lag of two to four days, then rapid fibroblast proliferation, the maturing fibrosis reaching practically full strength in two or three weeks.[4,18,22] Of course the repair of a hernia usually requires several injections over a period of weeks, with the final repair tissue reaching mature strength, say, three weeks after the last injection. Obviously the velocity of repair should properly determine the timing of injections and of truss wearing and removal. It should be studied further, however, with definite regard to the age of the patient (tissues of the old respond slower), his race (negroes have a keloid proclivity and probably a more rapid tissue repair rate), and his condition of health (anemia and diabetes, for instance, retard repair processes), etc.

9. *Repair Resorption.* A slow progressive resorption of repair tissue after maturation has long been suspected, and used to explain weakening and recurrence following both surgical and injection repairs.[7,8] Such resorption unquestionably does occur with some adhesions, notably those of peritoneum and omentum, and seems to be markedly aggravated by suppuration and prolonged truss pressure.

Resorption study in hernial repair tissues should be directed to determine: (a) if it attacks only the débris of the inflammatory and granulation stages; (b) if it proceeds by fixed tissue migration, by phagocytosis, or perhaps by ferment dissolution; (c) if it attacks connective tissue, what is its rate in relation to age-wasting, diseases, suppuration, truss pressure, etc. It is now well established that recurrence, whether due to resorption or not, can nearly always be forestalled by initial overbuilding of repair tissue, or by reinforcing injections later.[5,8]

10. *Solution Studies.* The several solutions and formulas proposed for hernial injection should be experimentally tested in relation to histologic and gross results as already indicated; such as possible tissue necrosis, undesired abundance of the phagocytic and scavenging leucocyte types, and excessive exudate characterizing acute inflammation. Or we have on the other hand, the desired abundance of the lymphocytes favoring the repair process. Studies should be made on the extent and persisting action of each injectant, its stability, concentration and proper dosage, the timing and number of injections with it, etc.—does persistence of action, for instance, depend on the colloid state of the irritant? The possibility is also suggested of utilizing or developing injectants stimulating repair processes directly, without prior stimulation of inflammatory reaction. Embryonic tissue juice and lymphocyte fluid do just this, and several auxetic or growth-inducing substances should be considered and experimentally tested, such as allantoin, the sulphydryls, the guanidine derivatives, or suitable modifications or equivalents of these. Obviously the coöperation of the creative biochemist is much to be desired. (See Paragraph 13.) Bratrud, in first tests with allantoin, cystein and oleic acid, secured no fibroblastic proliferation at all, suggesting that a minimum of irritation may eventually prove necessary.[6]

CLINICAL AND STATISTICAL STUDIES

As already indicated, the clinical experience with the injection treatment of hernia is extensive, covering some tens of thousands of cases. Significantly, that experience is quite consistent, particularly in recent years with modernized techniques and solutions. As this is an outline for suggesting and guiding research, results on which there is general agreement are broadly stated, but without citing specific references.

The new worker with the method, particularly if he is not familiar with its history and literature, is quite likely to spend much research time on confirming well established results and (with marked perversity) in repeating historic mistakes. The more obvious lines of research have appeared obvious before, and have probably already been thoroughly explored. Useful work, therefore, will now be found in other directions. Broadly they lie in two fields: first, that of biopsies and necropsies as above outlined; and second, in the follow-up and statistical studies of sequelae and end-results. There are of course some strictly clinical problems which still need study, and these will be indicated in the general account of clinical experience which follows:

11. *Indications and Contraindications.* If a hernia cannot be reduced, or controlled when reduced, it cannot be treated by the injection method. Presence of a fat pad in the sacs of femoral, umbilical or epigastric hernia causes pain when a truss is applied. Such cases should not be treated until this symptom has been completely relieved.[6] Strangulation is a definite indication for immediate surgical intervention. Undescended testicle on the affected side invariably contraindicates treatment by injection.[9] Hyperthyroidism and hemophilia are usually cited as contraindications. Cardiac conditions or diabetes do not contraindicate the method, but the latter retards repair, as do anemia, extreme age, flabby or very spare muscula-

ture, etc. An old or very large hernia is more difficult to treat by either injection or surgery, but surprising cures (or perhaps notable relief) sometimes result from persistent injecting. Excepting sliding hernias,[12] all the accessible abdominal hernias have been successfully treated, including incisional cases. Clinical experiences should of course be carefully recorded, and when significant, fully reported.

12. *Complications and Sequelae.* In general, it may be stated that most of the complications anticipated for the injection treatment have not been observed following proper injectants and techniques, and need not be here discussed.[10] The most frequent actual complication is an occasional acute inflammatory reaction indicating overdosage, readily controlled by hot or cold applications if severe. A few hydroceles have been observed, probably limited to the hernial sac, and soon subsiding without special care.[7,21] Rice, however, by aspirating such hydroceles and injecting an irritant into their lumina, succeeded in occluding the sacs completely.[26] Intraperitoneal injection (or drainage from the sac) is a rare accident, indicated by immediate crampish pains and more or less shock, but with apparently no permanent harm. Bratrud finds that even the normal injection of ricinoleate solutions very often causes severe after-pain or cramps and occasionally results in shock.[6] Impotence or sterility from the treatment has not been authentically reported by workers with the method. Two reports by others are known. In one the impotence appeared after an operation "following some injection treatment," but is ascribed to the earlier injection treatment instead of the later surgery.[15] The second report gave no histories, and private correspondence with the author disclosed lack of confirming tests, prior examinations or consideration of other possible causes.[29] On the other hand, Rea reports careful tests of twenty-six patients, and concludes that sterility does not appear to be a complication of the treatment. Furthermore, Rice, operating on thirty cases of hernia previously treated by injection, observed no stricture, obstruction or other difference in the vas deferens or other cord structures.[20] Swollen cord, atrophied or undescended testicles are conditions often found before treatment, only the last being a contraindication.[5,18] Routine examination before treatment should definitely include these conditions. When they are found, a definite prior record (preferably confirmed by the patient or another physician) should be made as a measure of legal protection and to insure statistical correctness in the reporting of sequelae. Complaints of impotence or sterility should be most carefully studied in the light of all possible causes, physical or mental, and the proper confirming tests made. That the psychological factor has significance is evidenced by complaints of impotence (or sterility) from patients who have been treated only on one side. All significant complications and sequelae should be carefully noted and fully reported.

13. *Solution Problems.* Solutions and formulas not already well proven should of course be subjected to cautious clinical tests as to their effectiveness in promoting repair and as to adverse reactions and sequelae, toxicity, etc., when injected into the tissues normally. In addition, large doses should be injected directly into the blood stream and peritoneal cavity of animal subjects to test for systemic reactions. Commercial promoters of certain proprietary solutions have made much of such an unessential feature as the inclusion of an anesthetic in the hernial injectant. The doubtful advantage claimed is merely the saving of a minute or so needed to inject a local anesthetic beforehand. Epinephrine should not be used with the anesthetic as some patients are very sensitive to it, and it both delays the desired quick anesthesia and prolongs it unnecessarily. Serious attention should be given to developing two practical suggestions due to Warren[30] and Bratrud.[5] The former em-

ployed three solutions; the first, less irritant, for children; the second for the majority of adult cases; and the third, rather drastic, for long-standing hernias and older patients. Bratrud suggests two solutions used alternately on a given case, or the one employed for general repair of the hernia as a whole, the other, stronger or more concentrated, for "touching up" points which remain weak. Suggestions for solutions of the auxetic rather than the irritant type have already been given in Paragraph 10.

14. *Truss Control.* During treatment by injection, a hernia must be kept continuously reduced. The initial problem in truss control is finding a truss-maker who can cooperate in the effective fitting of difficult cases. The type of truss necessarily varies with case conditions. The pad should be applied at the hernial opening, which in indirect inguinal cases is at the internal ring, not lower down as the pad is usually placed.* Extreme pressure has been prescribed by some workers, but experience seems to indicate that this is ordinarily needless. Besides, the truss may at first have to be worn day and night, so comfort is highly desirable, particularly as it promotes coöperation by the patient, which simply cannot be over-emphasized in securing complete and continuous hernial control. Pressure may be relieved as the repair progresses, but the burden of control must rest on the truss until the hernial repair tissue matures in strength. (See Paragraph 8.) The problem of taking a bath, without removing the truss, has been solved by the ingenious patient who covers the truss with patapar paper and takes a shower. Printed instructions to patients have proven helpful, and coöperation is invited in preparing a joint leaflet for general use. More specific problems are those connected with the time of removal of the truss after treatment. Should it be removed three or four weeks after the last injection, when the repair tissue is presumably matured, or should it be worn for several months? Does protracted wearing of the truss after treatment promote resorption and thus weaken the repair? Experience in large series of cases must be accumulated to answer such questions decisively.

15. *The Various Techniques.* In the evolution of hernial injection techniques, attention has been almost exclusively devoted to the inguinal hernias. A review of the outmoded techniques is warranted here only to prevent use of methods already found wanting. Injection by incision, trocar and canula, and various special instruments have finally given way before the simple and efficient hypodermic needle and syringe. The needle has been inserted by four general routes: (a) through the scrotum; (b) through the tissues at, then through the external ring into the canal; (c) vertically or nearly so, directly through the tissues over the point of deposit; and (d) caudalward and at a low angle through the tissues from about the internal ring. The finger invaginating the scrotum and inserted up the canal, has been used to guide the needle in various ways, but this probably tends to break up adhesions which are forming and thus prevents prompt and proper closing of the canal. However, this method has also been used only for the beginning of treatment, later reliance being placed upon external palpation of the induration which marks the progress of the repair.

Some of the earlier workers merely sprayed the walls of the canal with solution, being fearful of injuring the tissues. Today we purposely inject into these

* Since this writing a thorough discussion of proper truss types and fitting has appeared in an article by Franklin I. Harris and Alfred S. White on "The Truss in Relationship to Diagnosis and Injection Treatment of Inguinal Hernia" (*Am. J. Surg.*, N. S. 36: 443. May, 1937.) They find that generally pad pressure is not merely misplaced but is directed too much upward, and show truss types and devices which permit complete and positive maintenance of reduction without severe pressure. They describe a semi-rigid type and the ordinary frame truss as adaptable for the injection treatment, but condemn the spring and elastic types as practically always unsatisfactory. They also contribute most valuably on the diagnostic distinction between indirect and direct inguinal hernia.

fascial and muscular walls, finding that the needle wounding is inconsequential and that the solution infiltrates better so as to cause a more substantial repair. We no longer try to cure a case with one or a very few drastic injections, but by a series of injections we get milder reactions, an ambulatory case, better control over tissue placement, and in the end a more effective repair. We begin preferably at the internal ring in indirect inguinal cases and proceed with later injections towards the external ring, the injectant being deposited deep to the aponeurosis of the external oblique. In direct inguinal cases, the aim is to reinforce the yielding wall of transversalis fascia, the injectant being accordingly deposited in that structure. In treating indirect inguinal cases, Bratrud suggests injection into Hesselbach's triangle to reinforce that area and thus prevent the later occurrence of direct hernia. Also in treating direct cases, he advises injecting at the internal inguinal ring to anticipate the development of indirect hernia.[6] In femoral and other types of hernia, the injection method has been effectively employed, but definite techniques have hardly been settled upon. There is research to be done in this field, but it can probably not prove fruitful unless guided by the historic experiences and carefully checked by clinical and biopsy studies through long series of cases.

16. *Prevention and Child Cases.* One field of enormous possibilities, to date hardly appreciated, much less developed, is that of hernial prevention. For a weakening muscular or fascial structure can be reinforced, and the yielding hernial ring readily closed, by a few anticipatory injections. There will probably be more difficulty in discovering the weakening than in preventing its final yielding. Yet industrial, insurance and other physical examinations should disclose many threatening hernias which can readily be forestalled. Also recently acquired hernias usually respond quickly to the injection treatment, as do those of children. Through the first four years of life, spontaneous cure of a controlled hernia can reasonably be hoped for. Thereafter through childhood, a radical treatment, either surgery or injections, is practically always successful. Enough work has been done to demonstrate these possibilities, but much remains to be done in developing the practical techniques of handling child cases.[31]

17. *General Control of Hernia.* Closely related is the possibility of gaining virtually complete control of hernia as a public problem of health and efficiency, by the complementary treatments by surgery and by injections. Injections supplementing and reinforcing surgical repair, correcting its recurrences, preventing its own recurrences by initial over-building of repair tissue and by close follow-up with perhaps further injections, all this sums up an approach towards entire control over hernia throughout the nation. The education of the public is prerequisite, and probably presents more difficulties than those of actual cure. It must of course be preceded by a recognition of the method and willingness to coöperate on the part of the medical profession as a whole, but given these, surgery and the injection method together could, *with early treatment*, reduce the incidence of hernia by probably 95 per cent or more.[1]

18. *End-result Studies.* Acceptance of the injection method by the medical profession must depend upon the demonstration of its effectiveness, not only in securing immediate cures without serious complications, but also in a high percentage of lasting cures. Significant studies of end-results, however, take years of the most careful and thorough follow-up of a multitude of cases. Unlike surgery, the injection treatment is not essentially nor primarily a hospital procedure. But the office practitioner usually lacks the follow-up facilities and organization, for which reason relatively little has been done in this particular study. Mayer did report 98 per cent end-successes over a period of thirty years with over two thousand cases, but he gives no

details to establish the reliability of this figure.[19] Better authenticated data from German workers in several thousand cases over a period of some forty years indicate an end-success of about 94 per cent, even with the very ineffective injectant there employed.[33,34,35] Bratrud at the University of Minnesota Hospital Clinic, out of 707 cases, had only nine in which final closure could not be obtained.[5] He looks forward, however, to a considerable recurrence rate, as a substantial part of his series were large sized hernias, with many contraindications of surgery which also made the injection treatment difficult. McKinney, following up three hundred of these cases, found 83 per cent cured after six months to three and a half years. The preponderance of recurrences was found among older patients, and in the inguinal cases, among those with the fewest average number of injections, suggesting that age and insufficient treatment were major factors in causing failure.[17] Rice, following 379 patients after not less than six months, and counting only cases originally controlled by truss, reports 97.6 per cent cured.[26] Other series are receiving adequate study elsewhere, but are not yet large enough nor of sufficient duration to be as significant for some time to come. After experience with some 800 cases of my own, over a period of nearly seven years, I am convinced that Bratrud's immediate results are generally attainable, to be maintained in the end-results by persistent follow-up reinforcement in the more difficult cases.

In this field of statistical research, insurance carriers can contribute materially because of their continuing contacts with large numbers of cases. Concerted action should also be taken to secure comparable data by establishing uniformity in record keeping and to bring that data together for compilation. That might also make possible the gathering of much significant data now scattered among many private practitioners. Such records should of course include, not only end-results, but such other statistical subject matter as the incidence of complications, types of hernia treated, techniques employed, costs, etc.

19. *Economic Aspect.* The work "costs" suggests another phase of the method that warrants careful concerted study; the economic aspect. A cautious preliminary estimate, based on data from New York State workmen's compensation experience for a period of nine years, and on figures furnished by several large insurance companies, places the savings of the ambulatory injection treatment to the insurance carrier in New York State at about $250 per case.[27] Simply because the patient keeps right on working during treatment, the costs of surgical hospitalization and of work-time compensation are eliminated. In addition, the patient himself saves a comparable amount of those residual wage-losses for which he is not compensated. What the aggregate country-wide economy may be, only a general concerted study can reveal, but it obviously would run into the tens of millions per year. The much lower cost of this second method of radical cure would clearly make such treatment available to a much wider circle of hernia sufferers, as would also the avoidance of the surgical risks, real or imagined, but universally feared. If, too, widespread preventive work can be inaugurated, not only can the incidence of hernia and its final cost of treatment be appreciably reduced, but serious present losses from lowered industrial efficiency among herniated workers can be substantially decreased. The concerted study in this instance is definitely the business of the insurance carriers, the one organized major group which is largely involved.

COMMENT

Obviously, the significance of any studies which may be undertaken will depend fundamentally upon the skill with which the practical treatment is carried on. Unfortunately, the method is deceptively simple, for it does really demand specialist skill and experience for its successful application. Experimental work by begin-

ners on a few cases will have no practical nor research significance. Obviously, too, the extensive utilization of the method demands a large body of well trained workers. Unfortunately, however, our clinics and medical schools have so far taken few steps towards imparting such needed training.

The above is, after all, but a broad outline of the status of research in this promising field and a personal attempt at indicating the more immediate and important problems which demand attention. Naturally, many new and unforeseen problems and techniques will develop with wider experience and the extension of research. On the practical clinical side, the fundamental problems have been rather amply studied, so that the basic technique and the general effectiveness of the method are well established among experienced workers. There remains, however, a borderland of problems on which little has been done, the study of which by competent workers should make our techniques safer, more definite, and more effective.

The surgeon is the logical worker for carrying on this vital research. Hernial surgery has already, though perhaps unwittingly, contributed basically to our understanding of both the theory and the technique of the injection treatment. And it is today the surgeon who can supplement clinical studies with biopsies, and can draw upon the laboratory and follow-up service of the modern hospital, and who therefore can make all the necessary interrelated studies here indicated.

The hernial surgeon is also a logical practitioner of the method, for the surgical training gives that familiarity with hernial anatomy and conditions which best guides application of the injection method. But the surgeon should realize that to such knowledge he must add the special skill in palpation and "needle feel" which only practice can give, and particularly that he must gain that rather indefinable yet highly vital something which we describe as "experience." In short, this treatment demands such degrees of knowledge, skill and experience as properly elevate it to the status of a specialty.

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Observation, Reason, Human understanding, Courage; these make the physician.

Knowledge is a process of piling up facts; wisdom lies in their simplification.

We die of the things we know nothing about.

Think the way you please, but know why.

TWO FATTY ACID SOLUTIONS FOR THE INJECTION TREATMENT OF HERNIA*

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THE field of sclero-therapy has widened to include the injection treatment of hernia. This rational procedure is here to stay. The current literature, however, is extremely confusing due to the numerous contradictory opinions. It is the purpose of this paper to attempt to clear the atmosphere and present new safe solutions for hernial sclerosis.

There is no need to elaborate on the historical background. Yet it must be emphasized that the injection treatment of hernia is over one hundred years old. In 1835, Velpeau[1] used irritants to obliterate the inguinal canal by the production of fibrous tissue. Following him came an increasing wave of enthusiastic pioneers. These men, in the main, failed to convince the profession, although their results were apparently good.

There are several reasons why such an important treatment failed to gain recognition. In the first place, early investigators kept their formulae secret. Later, with the publication of reports by Heaton,[2] Janney, Lannelongue and Mayer,[3] other men were encouraged to duplicate their results. However, the causticity of their solutions produced many complications and discouraged progress. It was not until the more recent work of Bratrud,[4] Rice,[5] and Fowler[6] that the method gained widespread interest. A histologic background was built by these modern workers, and serious attention attracted to the new technic.

In its present stage, sclero-therapy for hernia rests on a rational basis. The technic has undergone few changes from the past, but the solutions are undergoing a rapid evolution. Research in the field of varicose veins has markedly influenced this new progress. There have been no solutions presented heretofore which were completely satisfactory for this treatment. There is as definite a need for safe solutions in this work as there is in the related field of varicose-vein therapy.

The complications listed in the literature are formidable. They include toxic absorption, pain, peritonitis, abscess formation, slough, cord swelling, hydrocele, testicular atrophy, and impotence. Most of these are due to improper solutions and are no criticism of the method.

To appreciate this point, one must remember that the solution is deposited in the fascial planes of the inguinal canal. I am convinced that there is widespread diffusion of the reagent in the region of the injection. I have observed this by the use of colored dyes in the cadaver, and by *x*-ray studies in the living subject. Figure 1 illustrates this latter method. This plate was taken after the injection of 5 c.c. of diluted Diodrast in the region of the internal ring. It shows the spreading of the solution throughout the inguinal canal. The cord, peritoneum, nerves and epigastric vessels are necessarily brought in contact with the injected irritant.

It is evidently of paramount importance that the solutions used do not injure these structures. At the same time they must be irritating enough to stimulate proliferative sclerosis. Furthermore, their toxicity must be so low that no poisoning results from accidental peritoneal penetration. These

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requirements have been met by two fatty acid solutions[7] originally developed for varicose veins. They are equally applicable to this technic.

SYLNASOL

Sylnasol is a safe tissue irritant. I have used it for one and one-half years in varicose veins, and one year for hernial obliteration at the Stuyvesant Polyclinic. Its toxicity is very low. It is calculated from laboratory tests in adult white rats that the human being can tolerate up to 450 c.c. Since the average injection is 3 c.c., there is obviously an enormous margin of safety. There was no occasion to repeat the histological work of Rice[8] showing the effect of Sylnasol injection. The definite promotion of fibrous tissue is a proven fact.

Clinically I have found that Sylnasol is a milk, effective and safe hernial obliterant. The injection is preceded by an ethyl chloride spray or a skin wheal of procaine. Deep procaine infiltration is inadvisable. Anesthetizing the parietal peritoneum robs the operator of a valuable guide, namely the pain of peritoneal penetration. Any sharp pain during the technic calls for immediate stopping and investigation. It is preferable to withdraw the needle in such a case and reinject at a different point. Occasionally, in sensitive individuals, I employ muscle infiltration to lessen the afterpain of the first few injections. However, in general, the safest procedure to follow is not to anesthetize any tissue deeper than the epidermis. This is sufficient to make the procedure painless in the usual case.

I have penetrated the parietal peritoneum four times with Sylnasol. In each case, the patient complained of pain on injection. A typical description of the resulting symptoms is as follows. The patient exhibits shock of varying degree; breathing is difficult; the face is pale; the hands cold and clammy. A peculiar painful series of abdominal cramps begins; the pains move away from the point of injection, going upward generally; sometimes they travel toward the rectum. The patient feels distended, belches, and wants to sit up. This should not be permitted because it increases the depth of shock. With rest in the supine position, the symptoms lessen and always disappear within thirty minutes. I have never observed any permanent effects following the intra-peritoneal injection of fatty acid solutions. In fact, this type of injection has sometimes aided the cure by promoting fibrous tissue in the plane of the transversalis fascia where it does the most good.

The initial dose of Sylnasol is one-half to 1 c.c. The needle I prefer is a three-inch 20 gauge. There is usually no pain at all with this solution if the technic is quickly and properly performed. One hour later the patient experiences a sense of soreness in the region of the treatment. The pain disappears within a few hours. I have found that having the patient rest for one-half hour following treatment will greatly diminish the post-injection soreness. After sclerosis is established, the pain following injection diminishes so that the latter half of the treatment is almost painless.

The succeeding doses vary with the delicacy of the patient's tissues and the progress of the case. The amount of solution is gradually increased until 5 c.c. is injected at one time. The average quantity used is 3 c.c. for each injection. Treatments are given twice weekly or, in sensitive individuals, every five to seven days.

Histological studies[9] have shown that there is an early lymphocytic infiltration following injection. This subsequently is replaced by fibroblastic proliferation and mature scar tissue. This initial lump produced by injection therapy is not to be mistaken for the final scar. It is merely the early inflammatory edema that will subsequently shrink and become unnoticeable.

One must not be misled by the apparent cure this initial swelling often produces. In many cases, the induration closes off the inguinal canal so that the hernia stays reduced even without a truss. I have known

of surgeons who boasted of such a one, two, or three-injection cure. They were mistaken as subsequent events showed. It cannot be emphasized too strongly that the result aimed at is fibrosis and not edema. This is a definite objective and the operator must continue to irritate until the scar tissue is apparent to the needle point. Furthermore, this scar tissue must be in the proper facial plane. Although this paper cannot include technic,[10] these fallacies must be mentioned in this discussion.

In those cases that do not show satisfactory sclerosis with 5 per cent Sylnasol, I have employed a 7½ per cent concentration. This stronger solution, however, should not be used at the outset of the treatment. I have never observed any allergic responses with this reagent and no necrosis has ever been noted. Cord swelling may occur with faulty injection, and occasionally a small hydrocele may form. Both of these complications disappear within a few weeks and are no barrier to the continuation of the treatment. In general, Sylnasol will be found safe and satisfactory for hernial obliteration.

MONOETHANOLAMINE OLEATE

This solution, which will be marketed under the name of "Monolate," is in my opinion a good fascial irritant. In a previous paper† I described this solution as a nearly perfect one for varicose veins. Clinical experience has proven its value in both fields.

In 1933, while studying sodium morrhuate,[11] I presented the following postulates for an ideal fibroblastic irritant:

(1) Incapability of slough formation.
(2) Freedom from pain on injection.
(3) Efficiency as an irritant.
(4) Non-toxicity.
(5) Purity and standardization of constituents.

Furthermore, I pointed out the inadvisability of using unknown mixtures of the "shot-gun" type. With the evolution of varicose-vein solutions, these requirements were gradually met. The history of proliferative solutions for hernial sclerosis is apparently repeating that of endothelial irritants. At the present time, many operators are still using haphazard mixtures resembling the older solutions for vein obliteration. There is no occasion to employ alcoholic solutions containing multiple toxic ingredients for injection therapy. A single known chemical, which is safe and efficient, is the solution of choice in this new field. Such a preparation is monoethanolamine oleate.

Fig. 1. Note outline of inguinal canal with use of Diodrast.

The chemical formula of this new preparation is as follows: $C_{17}H_{33}COONH_3$-CH_2CH_2OH. It is an organic base combined with oleic acid and is a definite chemical compound. It has a clinical background of more than a year, and has never produced any unfavorable reactions.

Monolate may be used in two strengths, 2½ per cent and 5 per cent. It is advisable, at the outset of a case, to start with the weaker preparation, reserving the 5 per

† See Reference # 7.

cent for the latter half of the treatment. The initial dose of the 2½ per cent is one-half c.c. Subsequent injections are gradually increased in amount until a total of 5 c.c. is given at a time. Skin anesthesia is secured, as in the case of Sylnasol, by the use of ethyl chloride or procaine. Deep anesthesia, as a preliminary to the injection, is again inadvisable. With proper technic, there is no pain on injection, and the usual soreness develops in one-half to one hour following injection. This transitory after-pain disappears within a few hours, rarely lasting any longer. No necrosis has been observed with the use of either concentration.

The induration produced by this solution is very firm and the resulting scar tissue very resistant. Occasionally, with poor technic, cord swelling or temporary hydrocele may result, but no permanent complications have been noted. There have been no toxic reactions and no manifestations of allergy up to the present writing. Intra-peritoneal injection has occurred a few times in this study, causing the same train of symptoms as with Sylnasol. Again, no permanent effects have been noted following these accidents.

A noticeable feature with Monolate is the uniformity of its action. As a result, accurate prediction can usually be made of the resulting reactions. Resistant cases will always respond to this preparation. I have never observed any inguinal canal that could not be sclerosed with 5 c.c. of the 5 per cent concentration. This potency is a valuable consideration in treating muscular males with well-developed fascia, who sometimes do not react with weaker preparations.

I have found it advisable to use the 5 per cent strength to finish most cases. The induration produced is very firm and the closure of the canal is satisfactory. As the treatment continues, the developing scar tissue can be felt by the needle point as a definite barrier to injection, and introduction of fluid into the sclerotic area becomes difficult. It is advisable to continue treatment up to the point where enough scar tissue has formed to hinder the introduction of more solution. Again, it must be emphasized that edema is not to be mistaken for scar tissue.

An average case of inguinal hernia will show approximately the following dosage schedule:

(1) 2½% M.O.—½ c.c.
(2) 2½% M.O.—1 to 1½ c.c.
(3) 2½% M.O.—2 to 3 c.c.
(4) 2½% M.O—3 c.c.
(5) 2½% M.O.—3 c.c.
(6) 2½% M.O.—3 to 4 c.c.
(7) 2½% M.O.—4 c.c.
(8) 2½% M.O.—5 c.c.
(9) 2½% M.O.—5 c.c.
(10) 5% M.O.—2 c.c.
(11) 5% M.O.—3 c.c.
(12) 5% M.O.—4 c.c.
(13) 5% M.O.—4 c.c.
(14) 5% M.O.—5 c.c.
(15) 5% M.O.—5 c.c.

This schedule of dosage must be varied to suit the individual case. In women and children, it may not be possible to exceed 3 c.c. of the 2½ per cent preparation. On the other hand, muscular males may not react to any irritation below 2 c.c. of the 5 per cent solution.

The area of injection must also be considered when choosing the proper concentration. Those tissues which have received previous injections and have undergone partial scarring can tolerate more irritation than that portion of the inguinal canal which has not had any treatment. In changing, therefore, to a new injection site, one must start with a weaker solution. The wide latitude of irritation, possessed by Monolate in the varying strengths, is an extremely valuable characteristic because it enables the operator to select the proper dosage for each injection. No solution previously considered possesses all these advantages. Monolate, at present, is an ideal hernial obliterant.

CONCLUSIONS

1. Poor solutions are responsible for most of the complications following the injection treatment of reducible hernia.

2. The fatty-acid solutions of the type used for varicose veins are suitable for hernial sclerosis.

3. Sylnasol is a safe tissue irritant which is extremely useful for hernial obliteration.

4. Monolate, a stable synthetic product, is a good obliterative agent.

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God's interest in the human race is nowhere better Evinced than in obstetrics.

The popular concept of a strengthening diet is a chicken wrung out in hot water.

The greatest discoveries of surgery are anesthesia, asepsis and roentgenology—and none was discovered by a surgeon.

The "fillers" in this number are from "Fischerisms . . . being a sheaf of sundry and divers utterances culled from the lectures of Martin H. Fischer, professor of physiology in the University of Cincinnati" by Howard Fabing. Published by Charles C. Thomas, Springfield, Illinois.

SCIATIC SCOLIOSIS*

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SCIATIC scoliosis was formally introduced as a clinical syndrome into medical literature in 1878 by Gussenbauer[1] who reported 2 cases of sciatica with secondary scoliosis. Several years later, in 1886, Albert[2] reported the same lesion under the title of "Uber Eine Eigentümliche Art der Totalskoliose," and in the following year Nicoladoni[3] discussed the same problem in an article on "Ischias Scoliotica." Since that time many studies have been made and essays written on this interesting subject. Up to a little more than a decade ago most of the observations were made in European clinics. Recently there have been many American students who have investigated the puzzling problem of the etiology and pathogenesis of so-called sciatic scoliosis. This condition has, as we shall note, an extensive and variable symptomatology, but there are two factors which are almost constantly present, namely a lateral deformity of the trunk, or scoliosis, and pain in the region of the sciatic nerve, or sciatica. Hence, the term sciatic scoliosis. This title does not accurately describe the symptomatology, etiology or pathology, and is often actually a misnomer, but its use must for the time being be continued because there is no more appropriate title, and it is justified because it serves to designate a definite and acknowledged clinical picture or syndrome.

Sciatic scoliosis may be defined as a lateral deformity of the trunk secondary to a painful minor lesion in the lower back or buttocks, or a sciatica. By the term minor it is meant to imply that there is not present any grave lesion of the bones or soft tissues. When, for instance, there is lateral distortion of the spine secondary to Pott's disease or a fracture-dislocation of a vertebra, the condition in the back is spoken of in terms of the essential pathology, namely, the tuberculosis or the fracture-dislocation, and not as a sciatic scoliosis. The word minor does not refer to the degree of the symptoms, which may not only be severe but even completely disabling, but to the absence of a major structural tissue change. The lateral tilt of the trunk is the result of an instinctive effort to assume a posture which will relieve or mitigate the pain.

SUBJECTIVE SYMPTOMS

Pain. This is the symptom which is uppermost in the patient's mind. It is located in the lower back, the buttocks or the back of either lower limb. I have never seen a case of sciatic scoliosis arising from a painful lesion in the upper back. The pain may be present simultaneously in the back and the lower limb, but usually it is in either one or the other location or at least predominantly in one region. When in the back the pain varies from mild to moderate. In the lower limb it is usually moderate and not infrequently excruciating. In the lower limb the pain is generally located in the back of the thigh and leg, along the course of the sciatic nerve, giving some justification for the title sciatic scoliosis. The pain is fairly constant and is aggravated by any motion of the trunk or lower limb which puts tension on the sensitive area. Thus, when the pain is in the back the spinal motions, especially at the extreme of each motion, increase it in varying degrees. In sciatica and in painful conditions in the buttocks and the sacroiliac areas, the pain is made worse by elevation of the lower limb with the knee in extension, so-called straight leg raising. When the pain is in the lower back it is generally

* From the Hospital for Joint Diseases, New York City.

relieved by rest in the supine position. When it is in the lower limb, lying sideways on the unaffected side with the painful limb flexed usually gives considerable relief. There is, however, no one or specific position that may always be relied upon to yield relief. Lying supine or on the side, standing, leaning forward on a table or even walking may each sometimes ease the pain and at other times prove intolerable.

Gait. The gait in all but the mildest cases is abnormal. In the very mild attacks there is no actual difficulty in walking, only a feeling of awkwardness which disappears after the patient has been up and about for a few minutes. However, each time the individual gets up from the recumbant or sitting position he walks poorly until the trunk becomes fixed by muscle spasm, after which the gait is fairly easy. The individual with sciatic scoliosis is usually robust, muscular, tolerant and not inclined to pamper himself. Consequently during mild attacks he carries on in his business or profession, standing, walking or even driving a car many hours a day. In severe attacks there is a marked limp and inability to walk more than a few feet at a time. There are all gradations between these extremes of locomotor disturbance. By and large the gait is slow and awkward and there is a distinct reduction in the capacity for physical exercise.

Stiffness of the Back. There is always a feeling of inability to bend or move the back freely. This results from the reflex or instinctive splinting of the spine to relieve or to prevent pain. The degree of stiffness varies with the intensity and location of the causative lesion. If the pathologic process is in the back, as in myositis of the erector spinae muscles or sprain of the intervertebral articulations, the stiffness is present in all positions of the body. On the other hand, if the deformity is caused by a sciatica, the stiffness is present only during standing and walking, while in the sitting or recumbent position the patient is able to move his back freely and painlessly. This constitutes a valuable differential point in ascertaining the site of the provocative lesion. In mild attacks the stiffness is of only brief duration experienced only during changes of posture. The patient under these circumstances has difficulty only for ten or fifteen minutes after getting up from the sitting or recumbent position and then can move his body and flex his spine freely. In severe and chronic cases the stiffness is constant. In fact, in the chronic cases the stiffness of the back is a fixed element and the result of intermuscular and periarticular adhesions, and constitutes a major factor in perpetuating the deformity and disability. It may even

Fig. 1. C. E., thirty-five years old, mild right sciatic secondary to strain of back; duration eleven weeks; secondary left sciatica; 2 inch atrophy of left thigh. Note flatness of back. Cured by stretching and immobilization in plaster-of-Paris spica jacket.

exceed in therapeutic importance the pain in the back or in the sciatic nerve.

Deformity of the Back. In mild attacks of sciatic scoliosis the patient is unaware of any deformity of the back. I have noted frequently that in questioning patients as to the duration of their deformity, they expressed surprise at the question, for they were entirely unaware that their bodies were inclined laterally. In the moderate and marked cases the patient knows he has a deformity. He is frequently made aware of this fact by the asymmetry of the lumbar region and the undue and often conspicuous prominence of the "hip" (the iliac crest) on the side opposite to the tilt of the body. The deformity often proves a blessing in disguise as the patient, interpreting this to signify some dreadful disease, not only rushes to his physician, but is quite willing to submit to the necessary therapy. The deformity of which the patient complained is a lateral and forward tilt of the trunk combined, in cases of severe sciatica, with flexion at the hip of the affected limb.

FIG. 2. D. A., male, 42 years old; typical moderate grade of sciatic scoliosis; left sciatic scoliosis secondary to traumatic arthritis of left sacroiliac joint. Reversal of physiological curve of spine; dorsal area flat, lumbar hollow replaced by convexity. Cured by stretching of back and immobilization in plaster spica jacket.

OBJECTIVE SIGNS

Deformity. This is the most conspicuous of the objective findings. Like all the other symptoms it varies in degree from slight to severe. The deformity consists of a lateral and forward inclination of the trunk. In cases with sciatic pain there is also a flexion at the hip and knee on the affected side exaggerating the flexion of the body. The back is abnormally flat. The backward curve in the dorsal region is reduced or may be obliterated. The lumbar hollow is diminished or may be replaced by a convexity. In extreme cases the normal physiological anteroposterior curve of the spine is actually reversed. There is a lateral curvature of the spine, the dorsal and upper lumbar vertebrae are deviated in a long curve to the side of the tilt of the body and the lower lumbar vertebrae are deflected in the opposite direction. The curvature of the spine differs from that in structural scoliosis in that there is very little rotation of the vertebrae. There is asymmetry of the iliac crests, the crest on the side opposite the body tilt is abnormally prominent. The lateral tilt of the trunk is most frequently (about 70 per cent) away from the painful side. In a minority of cases (25 per cent) it is towards the painful side, and in a small number (5 per cent) of the cases the deformity is of an alternating character. In mild and very recent cases the deformity disappears in the sitting or recumbent positions, but in the severe and protracted lesions the deformity persists in all attitudes. While flatness of the back is characteristic of sciatic scoliosis, occasionally there is a hollow back, that is, there is an increase in the lumbosacral angle.

Mobility of the Spine. All of the motions of the spine are restricted. The limitation is most marked in the severe and protracted cases. It is not equal in all directions. Anteroposterior mobility is affected to a greater degree than lateral motion. Forced movement of the spine, either voluntary or passive, elicits pain in the region of the major pathologic disturbance, as the sacroiliac joint or sciatic nerve. Actually only those motions are limited which cause tension on the diseased tissues. Thus in a sciatic scoliosis due to a right sciatica, lateral inclination to the right may be entirely free and painless, while lateral motion of the spine to the left may be both painful and markedly restricted. There is, however, no constancy in either the direction or the degree of restriction of the spinal mobility.

A B

Fig. 3. A, M. F., male, 35 years old; severe right sciatic scoliosis secondary to strain of right erector spinae muscle; duration several months. Note marked flexion of right thigh in addition to deformity of back. B, shows complete correction of deformity and functional cure, accomplished through stretching of back under anesthesia and immobilization in plaster spica jacket.

Muscular Spasm. This causes the limited motion in the back and is the result of the instinctive effort to reduce pain. It is seen in the muscles of the back on one or both sides of the spine, depending on the intensity of the pain and the need for splinting the back. In cases of sciatica any attempt to elevate the affected lower limb with the knee in extension causes spasm of the hamstring and gluteal muscles. This test of so-called straight leg raising is an important one in the examination. In a normal person of average build one can raise either lower limb with the knee in complete extension until it makes a right angle with the trunk. In this movement all of the muscles and soft tissues on the back of the thigh are put on tension, and through the hamstring muscle, the tissues on the posterior surface of the pelvis and ultimately those in the back are pulled upon. The straight leg raising test is valuable in sciatic scoliosis because it initiates or aggravates the characteristic pain in the

thigh, buttock or back, which, by its location, indicates the site of the essential lesion. The straight leg raising test may be

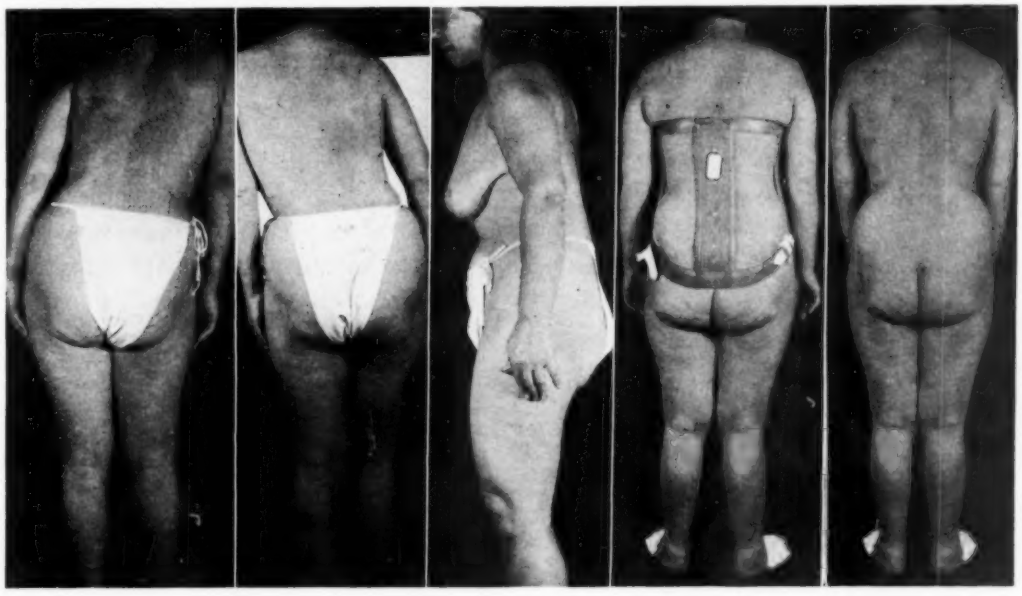
Fig. 4. Severe left sciatic scoliosis secondary to right gluteal myositis. Note very marked tilt of trunk and reversal of physiological curve of spine.

positive on both sides, but the pain which it originates or increases is always on the affected side and in one locality. The degree of limitation of straight leg raising depends on the severity of the symptoms. In very acutely painful cases with the patient lying on his back it may not be possible to raise either lower limb more than six inches from the table. The restriction is most often present in sciaticas, lesions of the gluteal muscles and derangements of the sacroiliac joints. The straight leg raising test is of importance in the diagnosis but not in the prognosis. As this sign is dependent on muscle spasm it is significant of a lesion in the back of the thigh, the buttocks and back of the pelvis, and is not limited to or pathognomonic of sciatic scoliosis.

Tenderness. This is a very important sign because its location indicates the area or areas of irritation or inflammation. Accordingly it may be found in the soft tissues or joints of the lower back, the sacroiliac joints, the buttocks or the back of the thighs or legs. The degree of tenderness depends on the severity of the lesion. In palpating to elicit tenderness one should examine carefully and slowly, covering only a small region at one time. Rough, careless or hasty palpation will yield erroneous information. Deliberate and accurate testing will give important evidence of the location, extent and intensity of the lesion. One must appreciate too that in seeking out tender areas the examination of the back is much more difficult than that of the knee where the structures are fairly superficial and easily accessible. For instance, if one finds tenderness over the sacroiliac area, it may be due to a lesion in the joint itself or the sacroiliac ligaments or the adjoining musculoaponeurotic attachment of the gluteus maximus. Consequently, in evaluating the diagnostic importance of tenderness one must take into account all the other symptoms and signs. As tenderness or pain on pressure is a subjective response one must be on his guard in the study of medicolegal and "compensation" cases that the elicited and alleged complaint is genuine. This is sometimes a most difficult task. The surgeon must use his ingenuity to apply the test in such a manner and at such times as will enable him to obtain an accurate judgment. The knee flexion test recently described by Nachlas[4] gives promise of the opportunity of gauging the existence or absence of a painful lesion in the lower back.

X-ray Findings. The roentgenogram of the back shows a scoliosis. If the body is tilted to the right there is a long right dorsolumbar curve and a short compensatory curve to the left in the lower lumbar

region. In a left sciatic scoliosis the curve of the spine is the exact opposite. The curvature of the spine in sciatic scoliosis is characterized by the fact that there is marked deviation and very little rotation of the vertebrae. One never sees the degree of vertebral rotation which is common in structural scoliosis. The deflection of the spine is temporary and disappears when the sciatic scoliosis is cured. In instances where the deformity is secondary to an arthritis of a sacroiliac or lumbosacral joint, the *x*-ray pictures will show irregularities in the outline of the density of the articular surfaces. Aside from these changes in the vertebral column or sacroiliac joints there is a conspicuous absence of osseous or articular lesions. One may find many anomalies, such as enlarged transverse processes, asymmetrical lumbosacral articulations, sacralization of the fifth lumbar, spina bifida occulta, a low or a high sacrum, and many others, but only rarely and exceptionally have these anatomical variants any relationship to the illness. It is true that theoretically any of them constitutes a locus minoris resistentiae, but, by and large, they are unrelated to the symptomatology. They were present many years before the appearance of the sciatic scoliosis and remain unchanged after the patient is completely relieved. Undue and unwarranted emphasis has been placed on these accidental and coincidental osseous anomalies with the result that unnecessary operations have been advised. The relief which has been reported in the cases subjected to major surgical operations has come, in many instances, from the prolonged rest in bed necessitated by the operations. I am convinced of this fact by reason of the cures obtained in a fairly large series of patients treated by conservative measures. There is only one possible exception to this opinion, that is, in cases of recurrent sciatic scoliosis due to a definite and persistent arthritis of the sacroiliac joint. In the latter situation an operative fusion of the ilium and sacrum is advisable.



A B C D E

Fig. 5. Alternating sciatic scoliosis; A, Nov. 18, 1935. Trunk tilted to the right; B, Nov. 21, 1935. Trunk tilted to the left; C, shows flatness of back; D, corrected back supported in a Knight spinal brace; E, Jan. 30, 1936. Complete cure, back normal in appearance and function.

Additional Signs in Sciatic Scoliosis Due to a Sciatica. In this type of case one often sees atrophy of the thigh and buttock and diminution or absence of the ankle reflex on the affected side. These changes are apparently due to involvement of the sciatic

nerve, but, as there is no associated motor, sensory or trophic disturbance, their exact pathogenesis is not understood.

HISTORY OF ONSET AND COURSE

Sciatic scoliosis is an illness of the vigorous and the robust. I have never seen this affection in the debilitated. It is most commonly observed between the ages of twenty and forty years. Occasionally it is found in the adolescent period and rarely in the fifth decade. When the deformity of sciatic scoliosis is seen in an individual past forty-five one must most carefully exclude a lesion of the spinal cord, a metastatic neoplastic focus in the vertebra or a retroperitoneal tumor. Men are much more commonly affected with sciatic scoliosis than women. It may appear in any of the following ways: (1) sudden onset following an injury, (2) sudden onset without an injury, (3) insidious onset, (4) the culmination of several mild or moderate attacks of backache.

1. *Sudden Onset Following an Injury.* An attack of sciatic scoliosis may follow a single injury as in lifting an unexpectedly heavy load. More frequently the trauma is simple or slight as rising from the stooped position, a sudden twist in bed or reaching overhead to pull down a window shade. One of the severest attacks I ever treated was in a man who had stooped to pick up a piece of paper from the floor. As he rose he felt a sharp pain in one sacroiliac area and he could not straighten completely. His trunk became tilted forward and laterally and remained so, resisting conservative treatment, until corrected some time later by a stretching under anesthesia.

2. *Sudden Onset without Injury.* An acute attack may appear without any definite trauma. It may persist, but usually it subsides under conservative treatment. The first attack may be the only one, but more commonly it is followed at intervals of weeks or months by others. Not infrequently every additional attack is likely to be more intense than the preceding one. One attack, unless treated vigorously and thoroughly, predisposes to recurrences. Unfortunately for the patient primary attacks are likely to be very mild and of short duration, not exciting the need for thorough therapy, and avoidance of undue strain. Swinging of a golf club is particularly likely to bring on an attack in an individual who is tense and unnecessarily vigorous in his strokes.

3. *Insidious Onset.* The onset may take place over a period of several weeks. At first the patient is aware of slight and inconstant discomfort in his back. This gradually increases until it becomes marked, and is accompanied by the characteristic deformity. The course and duration vary. The symptoms may subside on the institution of simple conservative therapy or they may become aggravated and require rigid treatment and even hospitalization.

4. *The Culmination of Several Attacks.* Sciatic scoliosis is not infrequently seen as the final result of a series of attacks of backache, each attack appearing after some, perhaps minor, injury. A dentist, thirty-five years old, had his first attack of backache as a result of a strain in a football game. He was well of this in a few days. A year later he strained his back in a game of basketball. It took him about a week to be rid of the pain. Several years later he hurt his back in diving. Thus every year or two he was incapacitated for a week or more with what he called "lumbago." Recently he tried to lift a window that was jammed. The backache returned, persisted and was followed by a sciatic scoliosis which had continued for six weeks when I was consulted.

ETIOLOGY

Any condition that is associated with low back pain may result in sciatic scoliosis. The common causes may be grouped as follows·

1. Lesions of the Joints of the Lower Back

   A. Sprains of the

      1. Sacroiliac joints

2. Lumbosacral joints
3. Lumbar intervertebral joints:

B. Arthritis of the
1. Sacroiliac joints
2. Lumbosacral joints
3. Lumbar intervertebral joints.

2. Lesions of the Muscles and Fascia of the Lower Back

A. Strains of the muscles of the back or buttocks

B. Myositis of the muscles of the back or gluteal region

3. Sciatica.

1. *Sprain of the Back.* In its acute and chronic forms sprain of one sacroiliac joint is a common, perhaps the most frequent, single cause of sciatic scoliosis. The conclusion that there is a sprain of one of the sacroiliac joints is made on presumptive evidence. A patient will give the history that in a sudden movement of his body, as in lifting an object or reaching overhead, he felt a sharp pain in the region of one sacroiliac joint. This persisted and resulted in disability and deformity of the back. The patient points to the sacroiliac area as the site of his pain and states that all movements of his trunk or lower limbs cause pain in the same locality. The affected area is tender to pressure. A roentgenogram is negative. These symptoms warrant the diagnosis of a sprain of the affected sacroiliac joint. The history and clinical findings of this hypothetical case have been duplicated many times. Swelling of the joint and periarticular tissues are naturally not evident as they would be in a similar lesion of the wrist or ankle, because of the deep location of the sacroiliac joint. Next in frequency as a cause of sciatic scoliosis is a sprain of the lumbosacral articulations. Sprain of one of the lumbar intervertebral joints initiates sciatic scoliosis, but not so often as involvement of the lumbosacral or sacroiliac joints. The exact location of the pathology is determined by (1) the site of the spontaneous pain, (2) the pain on indirect pressure or tension as during movements of the spine or on straight leg raising, and (3) tenderness to direct pressure.

Arthritis. When an irritation of the sacroiliac or lumbar joints, traumatic, static or otherwise, persists, there may ensue an arthritis of these joints, evidenced by pain, tenderness, disability and structural change in the joint as shown by a roentgenogram. An arthritis of any of the joints of the lower back can cause and is often responsible for a sciatic scoliosis. The diagnosis is based on the clinical manifestations and *x*-ray changes, and has been amply confirmed by histological study of tissue removed at operation.

2. *Lesions of the Muscles and Fascia of the Lower Back.*

Myalgia. This term is used to designate a traumatic derangement of the erector spinae or gluteal muscles. The exact pathology is not definitely understood, for there has been no opportunity for histologic study of this lesion. Presumably the lesion consists of a stretching or tearing of some of the muscle fibres. This is followed by hemorrhage and subsequent congestion incidental to repair. This is the condition which was formerly called lumbago, which in this limited sense is still an admirable term. One commonly obtains the history that following a sudden motion of the back there is felt a sharp pain localized in the back or upper buttock, which on physical examination discloses tenderness to pressure over the muscles in the painful area.

Myositis. As a result of an injury, repeated occupational trauma or an infection there may develop a localized inflammation in the muscles of the back or buttock which by its severity initiates a sciatic scoliosis. Clinically it is almost impossible to differentiate between a myalgia and myositis since the physical evidence is the same. One may rather assume that when a myalgia has lasted a long time, as several weeks, inflammation of the muscle exists. On one occasion the diagnosis of myositis of the gluteus medius muscle was confirmed by histological studies. A tear or

inflammation may involve the fascia or the fascia and muscle, in which condition the term myofascitis is permissible. Most often these soft tissue lesions are found near bony prominences, as the iliac crest, the sacrum or lumbar transverse processes, so that the pathological change involves the muscles, their aponeurotic attachments and the overlying fascia. There are some instances of myalgia or myositis of toxic origin. The onset of this type of lesion is insidious and probably due to an infection in the teeth or tonsils or to an intestinal stasis. Correction of these conditions cures the myositis and the sciatic scoliosis, if of short duration. This observation has the important significance that in every case of sciatic scoliosis a dilligent investigation of all systems must be conducted and all avenues and sources of infection eradicated.

3. *Sciatica.* Sciatica, sciatic neuralgia or pain in the areas supplied by the sensory fibres of the sciatic nerve, when severe or chronic, often gives rise to sciatic scoliosis. There are cases of sciatic scoliosis in which the sciatica is the primary factor and in which there is no pain anywhere except along the course of and in the areas supplied by the sciatic nerve. These are cases of sciatic scoliosis secondary to the sciatica. But there are instances of sciatic scoliosis secondary to a sacroiliac and lumbosacral derangement, sprain or arthritis, in which the sciatica is a concomittant symptom. It is well to differentiate between these forms of sciatica, since in the former the treatment must be directed specifically to the relief of the sciatic pain, while in the latter the treatment must be administered for the cure of the joint derangement. There is much uncertainty about the pathology of sciatica. It is likely that the lesion is a perineuritis of the nerve in the pelvis or the buttock. In the pelvis the nerve is very close to the sacroiliac joint and the lumbosacral joints, and a lesion such as a sprain or arthritis of any of these joints accompanied by swelling could obviously give rise to perineural irritation. Freiberg[5] of Cincinnati, has suggested that because of the intimate relationship between the sciatic nerve and the pyriformis muscle, spasm of this muscle would cause sciatic pain. This seems plausible and already many cases have had a sectioning of the pyriformis muscle to release pressure from the sciatic nerve. It is too soon, however to judge the results. Ober[6] believes that tension, spasm and contraction of the tissues between the iliac crest and greater trochanter of the femur cause the sciatica and advises a fasciotomy in the gluteal region. We know that in many cases of sciatic scoliosis there is a more or less marked sciatica. This may arise from a variety of causes within or external to the pelvis. As yet the differentiation of the modes of origin of sciatica is not clear.

PATHOLOGY

The pathology of sciatic scoliosis is primarily that of the exciting lesion such as sciatica, sprain or arthritis of the sacroiliac or lumbar articulations or derangement of the soft tissues of the lower back. When the deformity has been existent for a long time it persists in all attitudes of the body. At this stage there is additional pathological change in the muscles of the back consisting of unilateral contraction of the back muscles with adhesions between the muscles and about the vertebral joints (vertebral periarthritis). The latter conclusion is based on the observation that in the chronic cases the deformity of the trunk is cured by vigorous stretching under anesthesia, during which procedure one hears and feels the breaking up of adhesions in much the same manner as in stretching a shoulder that has been the seat of a chronic subdeltoid bursitis or periarthritis.

I recently reviewed eighty cases of sciatic scoliosis treated on my service at the Hospital for Joint Diseases in New York. Table 1 shows that about 66 per cent of the patients were in the fourth and fifth decade of life; another 15 per cent were between 20 and 30 years old; approximately 81 per cent of all cases were between 20 and 50 years of age. A little over 77 per

cent were males. These figures correspond closely to those obtained in a study of 50 cases[7] of scoliosis made seven or eight years ago at which time I found 78 per cent of sciatic scoliosis in individuals between 20 and 50 years old and 74 per cent in males.

TABLE I

ETIOLOGY OF SCIATIC SCOLIOSIS ANALYSIS OF 80 CASES

Age	Decades							
	First 0	Second 6 7.6%	Third 12 15.2%	Fourth 33 42.3%	Fifth 20 25.6%	Sixth 6 7.6%	Seventh 1 1.1%	Unmentioned 2 adults
Sex	Males 62 cases, 77.5%				Females 18 cases, 22.5%			
Occupations	Males							Females
	Salesman Printer Chauffeur Merchant Student Painter Broker Presser Peddler Bookkeeper	Laborer Helper Awning maker Silk manufacturer Iron worker Caretaker Janitor Advertiser Iceman Plumber	Cook Pharmacist Shipping clerk Floorer Butcher Knitter Neckwear operator Office worker Rabbi Physician					Housewife Student Nursemaid Hairdresser Schoolteacher Saleslady Nurse Dress operator
Trauma	Mild 7 cases, 8.7%				Severe 29 cases, 32.5%			
Onset	Insidious 25 cases, 31.25%			Abrupt 53 cases, 66.25%			Unknown 2 cases, 2.5%	

Occupation. As will be seen by reference to Table 1, sciatic scoliosis is not a complication of any one type of occupation, occurring in individuals who lead a sedentary life as well as those who engage in considerable physical activity. The analysis shows 40 different types of employment among 80 patients.

DIFFERENTIAL DIAGNOSIS

In view of the well known fact that there are ever so many causes of backache it is assumed that, whenever the diagnosis of sciatic scoliosis is contemplated, a searching and thorough physical examination has been conducted to exclude (1) a general systemic upset such as the exhaustion following a prolonged enervating illness or severe anemia, (2) an abdominal or retroperitoneal lesion especially a gynecological derangement, or a lesion of the genitourinary organs, and (3) disease of the spinal cord, meninges or spinal column.

Spinal Cord Tumor. In every case of sciatic scoliosis it should be borne in mind that it is imperative to have a neurological survey. In the well established cord tumor there are characteristic sensory and motor disturbances, a cord level of the sensory changes, modification in the reflexes, diminution in or loss of control of the bladder

and rectum and a definite "block" obtained by spinal tap which establish the diagnosis. In the early phase of cord tumor, however, the symptoms, such as backache, tenderness of the spine and rigidity of the vertebral column, are common to both cord tumors and sciatic scoliosis. One must, therefore, be on his guard to detect even slight alterations in the reflexes, sensations, etc. To this end frequent neurological examinations are advisable. Compared with the incidence of sciatic scoliosis cord tumors are relatively uncommon. I have seen and treated at least several hundred cases of sciatic scoliosis but have encountered only four or five cord tumors. Consequently, while we must bear [a cord tumor] [in mind], and frequently examine for it, a diagnosis of its existence cannot be made until there is a pathognomanic or at least strongly suggestive symptomatology.

Table II

X-RAY FINDINGS IN 41 CASES OF SCIATIC SCOLIOSIS REFERRING SPECIFICALLY TO THE LUMBAR VERTEBRAS AND PELVIS

X-ray Findings	Cases	Per Cent
Sacroiliac arthritis	16	39
Lumbar arthritis	9	22
Lumbosacral arthritis	2	5
Sacralization of lumbar vertebra	3	7
Negative	11	27

Tuberculosis of the Spine. In the typical case of Pott's disease there are not only localized pain and tenderness but a kyphosis or angular deformity of the spine, cold abscess, paraplegia and *x*-ray evidence of a destructive process in one or more vertebrae which leave no doubt as to the exact diagnosis. In early cases the objective signs may not be conspicuously evident, but on close examination in instances of Pott's disease causing a lateral tilt of the trunk, the rigidity of the spine would be found to be present continuously in all positions of the patient, even when he is lying down. Palpation will reveal the suspicious "knuckle" at the site of tenderness, and an *x*-ray study will disclose characteristic loss of bone, indicative of a destructive vertebral lesion, and often a shadow suggestive of paravertebral abscess.

Table III

DEFORMITY OF THE BACK IN 76 CASES OF SCIATIC SCOLIOSIS

Standing position	Trunk tilted to painful side	25 cases	33%
	Trunk tilted to well side	48 cases	63%
	Alternating deformity	3 cases	4%
Prone position	Tilt of trunk disappeared	25 cases	33%
Physiological curve of spine	Flatness or diminution of curve		72%
	Reversal of normal curve		16%
	Exaggeration of the normal curve		10%
	Lumbar lordosis 6%		
	Dorsal kyphosis 4%		
	Unrecorded		2%

Syphilitic spondylitis presents the same picture as Pott's disease.

Rheumatism of the Spine. In osteoarthritis of the spine the clinical symptoms may be more or less identical with those in sciatic scoliosis, but the *x*-ray pictures show an extensive involvement of the intervertebral joints with the formation of numerous osteophytes at the articular processes and the margins of the vertebral surfaces. In spondylitis deformans the subjective symptoms are comparatively mild, there is rigidity of the whole spine, there is a flexion deformity of the spine, frequently with involvement of the temporomaxillary, hip and shoulder joints. The *x*-ray film of the spine will show extensive characteristic new bone formation all along the vertebral column, ankylosing the vertebrae.

Infectious spondylitis of typhoid, gonorrheal, influenzal or pneumococcic origin comes on during the convalescence from or soon after an attack of typhoid fever, gonorrhea, influenza or pneumonia so that the association and the etiology are readily established. The lesion in the spine would very likely involve not only the lumbar but the dorsal segment or even the whole vertebral column. The *x*-ray pictures give conclusive evidence, since in these generalized infections most if not all of the

intervertebral joints are involved, and the joints instead of being clear appear hazy and are definitely the site of an inflammatory process. In the advanced and severe cases paravertebral abscesses and osteomyelitic foci may be found.

Table IV
TREATMENT OF SCIATIC SCOLIOSIS
An Analysis of Various Measures Used in 64 Cases

Treatment	Cases	Per Cent
Rest in bed	2	3.1
Caudal block	1	1.5
Novocaine injection of sciatic nerve plus stretching and plaster spica	3	4.8
Stripping of gluteus medius plus plaster spica	3	4.8
Application of plaster spica without stretching	6	9.2
Traction plus plaster spica	2	3.1
Stretching of back and affected limb, plaster spica, followed by Knight spinal brace and physiotherapy	47	73.4

Neoplasms. Tumors of the vertebrae, either primary or more frequently metastatic, are rather easy to diagnose at all but the earliest stages because (1) they are usually found in people beyond middle age while sciatic scoliosis is most frequent during the third and fourth decades; (2) the pain is of an intense, boring, unremitting character both at the site of the disease in the back and along the course of the nerves issuing from the spinal canal in the vicinity of the disease, and (3) the *x*-ray studies of the spinal column reveal a destructive lesion. Difficulty might arise in the younger age periods and during the early stages of the tumor invasion when there are much slight alterations in the texture of the vertebrae that the roentgenogram does not clearly exhibit them.

TREATMENT

It is assumed that before treatment is directed to the correction of a sciatic scoliosis that a complete physical examination and a thorough study of the case have definitely excluded the presence of a derangement or dysfunction of the various systems such as the osseous or nervous systems or the pelvic, genitourinary or abdominal organs. In the presence of any systemic disturbance it, and not the sciatic scoliosis, should receive the primary attention. In particular one should be on the lookout for a cord tumor or a malignancy of the spine, the early symptoms of which may be very vague. Should some focus of infection be found, such as an infected tooth, diseased tonsils, sinusitis, prostatitis or intestinal stasis, it should receive appropriate therapy in the hope that the painful deformity will disappear. One must, however, appreciate that there may not be, as so often happens, any causal relationship between the infected tissue and the sciatic scoliosis, and that after the infected focus has been cleared up the sciatic scoliosis may persist and require the specific therapy which will presently be described. The discovery of an osseous anomaly in the lower back, such as an enlarged transverse lumbar process, a sacralized lumbar vertebra, asymmetrical lumbosacral articulations, a high or low sacrum, etc., does not warrant an operation, except under very unusual and rare circumstances, for these anomalies, present since birth, are extremely unlikely, during adult life, to become suddenly symptom producing. As a matter of experience, sciatic scoliosis can be cured without any attention to them.

The local therapy to the back depends on the type and degree of the sciatic scoliosis which, for convenience, may be divided into mild, moderate and severe forms.

Mild Sciatic Scoliosis. This is the type in which the symptoms are not only mild but intermittent. The patient is inconvenienced to such a slight degree that he may be inclined to neglect treatment. Nevertheless, treatment at this stage is most desirable because it is readily effective and because it prevents the onset of the more marked and resistent forms. The most important single measure is absolute rest in bed for several days to a week on a rigid surface obtainable by inserting boards between the spring and mattress. Strapping of the back and physical therapy by daily

baking, diathermy and massage help to relieve the pain, dissipate the pathology and hasten the cure. The soothing effect of these physical therapy measures can best be appreciated by a personal experience. In the event that continuous rest in bed is not possible, the patient should avoid all strenuous exercise, such as lifting or pushing. He ought to rest on a couch several times a day for brief periods and wear a long "sacroiliac" or low back belt for support of the lumbar region and pelvis. In the majority of instances the symptoms will disappear within several weeks. As a preventative measure the belt should be worn for several months.

Moderate Sciatic Scoliosis. In this degree of sciatic scoliosis the deformity has existed for some weeks or even months, is always present when the patient is standing or sitting, but diminishes or disappears in the recumbent position. The pain is nearly constant and disabling. Preferably the patient should rest in bed for several weeks, making no attempt to get out of bed until all pain has disappeared and there is no tendency for the deformity to recur in the sitting position. Thereafter he ought to receive physiotherapy for several months and wear some form of low back support such as a brace, corset or belt. If rest in bed is not possible a temporary rigid support should be applied. The most effective protection is a plaster-of-Paris jacket. A celluloid corset, a Knight spinal brace or similar brace may do, but a non-removable protection as a plaster jacket is the more desirable. After a month or six weeks, if the symptoms have subsided, a removable support as a brace, corset or a low back belt may be used and physiotherapy instituted and continued for several months. When the sciatica is primary or predominant there are available various additional measures which at times are effective. If bed rest is possible continuous traction on the affected limb with five to ten pounds may give relief. When the individual is ambulatory and receiving physiotherapy, manual stretching of the sciatic nerve is frequently effective. This is accomplished by keeping the well limb in extension and forcibly flexing the affected limb while the knee is in extension. Cauterizing the buttock, back of the thigh and leg is at times an excellent means of relieving pain. If these measures used over a period of several weeks have failed, the sciatic nerve may be injected with 1 per cent novocaine. This is most effective when the injection is made in the buttock, the fluid striking the nerve as it emerges from the pelvis, 10 to 20 c.c. of solution being sufficient. The injection should be made around rather than into the nerve. Consequently when the needle strikes the nerve it should be withdrawn a little so that the injected fluid will bathe and not penetrate the nerve. Several such injections may be made as they sometimes are quite helpful in tiding the patient over the painful periods. When the preceding therapy has failed, one may employ a caudal block injecting 40 to 100 c.c. of 1 per cent novocaine or simple saline solution into the neural canal at the sacral hiatus. The candal block may be repeated several times. It occasionally gives lasting relief but in my own experience is of only temporary aid. Nevertheless, it is well worth using in obstinate cases before undertaking the more radical treatment. Many cases of this grade of sciatic scoliosis can thus be effectively managed. All too often the deformity and the symptoms persist or even become aggravated. In that event the treatment should be that accorded the severe form.

Severe Sciatic Scoliosis. In this type of lesion we are dealing with a patient who has great pain, more or less total disability and a deformity which persists in all attitudes, standing, sitting or recumbent. The symptom complex is the culmination of many milder attacks or the result of a single severe attack, and has been present for many weeks and not infrequently many months. The persistence of the deformity has given rise to adaptive changes in the soft tissues of the back so that in addition to the primary derangement in the sacroiliac or lumbosacral joints, sciatica, gluteal myositis, etc., there are paravertebral and

intermuscular adhesions and adaptive contractions of the spinal muscles. The treatment must, therefore, include a thorough stretching of the tissues of the back and mobilization of the spine to permit the re-establishment of the normal curve of the spine and symmetry of the back. In addition, when there has existed a severe or prolonged sciatica, the sciatic nerve should be stretched to overcome the perineural adhesions.

Stretching for Severe Sciatic Scoliosis. In the typical case, therefore, the treatment is the following: The patient is admitted to the hospital and given a good night's rest with sedatives. On the following day he is taken to the operating room and under a general anesthetic the back and affected limb are given a thorough stretching. If the sciatica is marked the affected sciatic nerve is stretched before the spine is manipulated. This is accomplished by slowly elevating and flexing the affected limb at the hip with the knee in extension, the well limb being held down in line with the trunk. As the affected limb is raised a great resistance is encountered from the spasm in the hamstring muscle. Not infrequently the sciatic nerve can be felt as a very tight cord. This stretching should be carried out very slowly and never suddenly in order to avoid tearing the sciatic nerve. I allow no less than five minutes and in the difficult cases ten minutes for this procedure. The stretching is continued until the foot is within twelve to eighteen inches of the face.

The back is then stretched as follows: The patient is placed on a Hawley table. An assistant supports or immobilizes the chest with his hands. The operator takes hold of the lower limbs and swings them to one side as far as possible, thus stretching the spine. The lower limbs can be brought around until they form about a right angle with the trunk. This maneuver is executed slowly but vigorously. The limbs are then swung in the opposite direction and held there for a few moments. The lower part of the table is then dropped. The patient's buttocks are placed on the sacral rest and the lower limbs are hyperextended at the hips thus stretching and hyperextending the lumbar spine and re-establishing the normal lumbar hollow. At this stage it will be found that the back is quite symmetrical and the physiological curve of the spine normal. During this manipulation and stretching of the back one may feel and even hear the tearing of adhesions.

The patient, having had a stockinette shirting and drawers put on is ready for the application of a support. The lower limbs are held in extreme hyperextension at the hips. A felt or thick cotton pad is placed lengthwise over the back. Several layers of sheet cotton are rolled over the trunk from the nipple line down and a plaster-of-Paris jacket is applied. When the plaster has set so that the lordosis is maintained, the lower limbs are elevated into line with the trunk and the plaster dressing is continued down the affected limb to the toes, the knee being held in slight flexion and the foot at a right angle to the leg. The completed support is a spica jacket immobilizing the trunk and the painful lower limb.

The plaster is left on for three weeks. In the majority of cases when the patient regains consciousness he will volunteer the information that all of the old pain is gone. The change from constant misery to comfort and contentment is quite dramatic and proof that the manipulation has broken up adhesions and released painful tension. During the first three or four postoperative days there may be some abdominal distention which requires medication. Thereafter the patient needs only the ordinary nursing care. It adds to the patient's comfort to elevate the head of the bed, this is true in almost all instances in which a plaster spica is being worn, as it enables the patient to look about instead of continuously staring at the ceiling. Several times a day the patient is turned and allowed to lie in the prone position for an hour or more, permitting appropriate care of the back and preventing the formation of bed sores.

After three weeks, the plaster is removed and measurements taken for a Knight

spinal brace. During the succeeding ten days the patient is given baking and massage to his back at least twice a day. Gradually increased voluntary exercises of the muscles of the back and lower limb are performed to improve muscle tone and facilitate subsequent standing and walking. This is a most important step in the routine. Its neglect is likely to precipitate a recurrence of the deformity. Three or four times a day the patient exercises the muscles of his back and the affected limb. At first he flexes his hip and knee. Then he raises the limb from the bed. Each exercise is performed twenty to thirty times. He then elevates his limb and moves it laterally. Finally he lies prone and learns to arch his back and elevate or hyperextend his lower limb. At the end of a week or ten days the exercises can be performed vigorously and without much effort. The brace is then applied and the patient is allowed to sit up for a few minutes. Each day the patient sits up a little longer. Within a few days walking is begun and soon the patient may be discharged from the hospital. The entire postoperative treatment can be carried out at home but for the average person, however, hospital care is the more convenient. The patient gradually increases his activity, wears the brace when out of bed, and receives physical therapy to his back and leg several times a week for about three months, at the end of this time he is able to resume all but laborious work.

Open Operations. These are indicated in specific cases. When the symptoms point to an inflammatory involvement of the gluteus medius or maximus it is well to strip these muscles from the ilium. This type of operation has given very satisfactory results, as reported by Roberts and Heyman,[8] even when there has been no histologic proof of a myositis. Should the lateral deformity of the trunk persist after the gluteal stripping, a secondary stretching and plaster-of-Paris immobilization will have to be employed. In those cases in which there is a definite sacroiliac arthritis, which has not yielded to the rest following the stretching, an extra-articular or intra-articular fusion of the sacroiliac joint should be performed. In recurring and obstinate lumbosacral arthritis a spine fusion is advisable. However, I would emphasize the fact that open operations in sciatic scoliosis should be employed only as a last resort since the conservative treatment is so frequently adequate and successful.

SUMMARY

Sciatic scoliosis is a clinical syndrome resulting from a minor painful lesion in the muscles, fasciae or ligaments of the lower back, the intervertebral or sacroiliac joints, or a sciatica. It is characterized by a lateral tilt of the trunk and a variable disability. The deformity disappears when the symptoms are relieved. The symptoms when mild disappear readily. When severe or recurrent they tend to chronicity. The majority of patients can be cured by conservative measures as outlined. In a small per cent of selected cases operative intervention for the release of the attachment of the gluteal muscles or the fusion of the sacroiliac or lumbosacral joints is necessary. The diagnosis of sciatic scoliosis should not be made until a thorough study of the patient has excluded an organic disease of the spine, spinal cord, and the abdominal and pelvic organs.

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DIVERTICULOSIS OF THE COLON

ITS INCIDENCE IN 7,000 CONSECUTIVE AUTOPSIES WITH REFERENCE TO ITS COMPLICATIONS*

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ACCORDING to Lockhart-Mummery and Hodgson diverticulosis is the most common pathological lesion seen in the large intestine and is responsible for the majority of cases of disease of the colon brought to the attention of the surgeon and the roentgenologist.

The symptomatology was first described twenty-eight years ago by Mayo, Wilson and Giffin. In 1907 they reported five cases in which a portion of the sigmoid was excised for obstructive diverticulitis, the first instances recorded in which an actual demonstration of the pathologic change in diverticulitis was made during the life of the patient. In 1854 Virchow gave a minute description of the condition referring to it as "chronic adhesive peritonitis" and which Wilson, later, so appropriately called "peridiverticulitis." Graser of Erlangen in 1898, as a result of postmortem studies, emphasized the frequency and significance of the disease. His article revived interest in this morbid condition and served as a stimulus to further investigation. Contributions followed in rapid succession by Fischer, Beer, Moynihan, Mayo, Wilson, Giffin, Telling and others. In 1914 the condition was first recognized by roentgenologists. Since then the diagnosis of uncomplicated diverticulosis has rested securely on radiographic evidence.

In true or congenital diverticula all intestinal coats form the sac. In false or acquired diverticula the mucous membrane pouches through small openings in the musculature and hence the wall of these diverticula lack the muscular layer. This paper is confined to this latter type of diverticula. Rankin states that the rarity of the former type makes their inclusion unnecessary in any general classification of diverticula either from the anatomical or the etiological standpoint.

Diverticula were found in 111 cases or 5.2 per cent of 1925 necropsies performed at the Mayo Clinic from 1924 to 1928. In this series all but one patient was over 40 years of age. There were 169 cases of diverticulosis and diverticulitis found in 16,283 autopsies performed at Bellevue Hospital between 1904 and 1930; but, because many of these were limited to the head and chest, these figures are not reliable. In 1819 cases, or 5.71 per cent, diverticula were present in 31,838 *x*-ray examinations of the colon performed at the Mayo Clinic; only 20 of these patients with diverticula were less than 40 years old. Spriggs and Marxer found 100 cases of diverticulosis in 1000 *x*-ray examinations. Edward reports that among 621 patients in which an *x*-ray examination of the colon was made at the King's College Hospital fifty-five cases, or 8.9 per cent, revealed diverticula. Of the 621 examinations 114 were made on patients of 35 years and under in whom no diverticula were found. Thus fifty-five cases were found in 507 examinations over 36 years of age giving a percentage of 10.80 for this age group.

The figures derived from *x*-ray examinations cannot be regarded as indicating the general incidence of diverticula, for all of them are made on patients suspected of pathological processes of the colon. The actual occurrence for all ages according to Rankin is probably less than 1 per cent as estimated from the finding of diverticula in 2310 cases in the course of 765,795 examinations (1916–1928). Larimore in 1925 found definite evidence of diverticulosis in thirty-

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five, or 1.65 per cent, of 4408 patients. Ochsner and Bargen found that 0.4 per cent of the patients who registered at the Mayo Clinic for one year showed diverticulosis. Six and nine tenths per cent of 447 cases which came to necropsy in the same period showed diverticulosis.

MATERIAL

In order to obtain additional information about the frequency of diverticulosis according to age, sex and race and about some of the most frequently associated pathological processes, I have collected the data from 7000 autopsies which were performed at the Cook County Hospital between January 1, 1929 and February 23, 1935. To my knowledge so large a number of necropsies has never been studied with this particular problem in mind. Since the majority of cases are symptomless I shall attempt to determine in what class or type of individual one should suspect this condition.

DIVERTICULA. *Total Frequency—Relationship to Age, Sex and Race.* Among the 7000 consecutive autopsies there were 127 cases, or 1.81 per cent, of diverticulosis. In six cases the cause of death could be attributed to one of the complications of diverticulosis. Since 120 of these cases were 41 years of age or over, my statistics shall deal only with the cases over 40 years of age thus giving much more reliable information than the inclusion of all cases. Of the 120 cases 115 were uncomplicated.

Arranged according to age, sex and race, the frequency of diverticula is shown in Table 1. The figures give the percentage of diverticula to the number of necropsies performed in each class.

After 40 years of age the incidence of diverticula increases gradually in number and after 60 years of age the increase becomes very pronounced. Two-thirds of all cases over 40 years of age were found in persons over 60 years of age. With reference to sex Mayo reports the incidence of diverticula as being 64 per cent in men and 36 per cent in women. Hustin and Rankin quote similar figures. Wilkinson quotes somewhat different figures; he found 37 per cent males and 63 per cent females in 117 clinical cases of diverticulosis and diverticulitis. In my series one will note that after 40 years of age the incidence in both the white male and in the colored female approximates 23.5 per cent of the total number of cases of diverticulosis while in the white female the incidence is 37.6 per cent or over one-third again as much; the incidence in the colored male is 15.4 per cent or two-thirds of that of the colored female. There were only two-thirds as many colored persons with diverticula as white persons.

TABLE 1

Age, Years		White Male	White Female	Colored Male	Colored Female
21–30	Number	0	2	0	2
	Percentage	0	1.9	0	1.19
31–40	Number	0	2	1	0
	Percentage	0	1	0.45	0
41–50	Number	4	3	5	3
	Percentage	0.8	1.5	1.9	1.6
51–60	Number	10	5	5	3
	Percentage	1.9	2.8	2.5	3
61–70	Number	28	9	4	5
	Percentage	6.4	6.9	4.4	9.3
70+	Number	18	16	1	1
	Percentage	7.1	15.2	2	3

In this series the weight of the individuals is not given. I do not believe that it would be a reliable index since most of these persons died after a prolonged illness and their weight at postmortem would be no indication of their state of nutrition during health.

Location of Diverticula. Diverticula may be found throughout the entire colon, usually with increasing frequency from right to left. Rankin states that in a series found at necropsy, which is more accurate than clinical observation, diverticula occurred in the sigmoid colon in 29 per cent,

and in the sigmoid and other parts of the colon in 68 per cent, and in any part but not in the sigmoid in 3 per cent. Wilkinson reports a series of 117 clinical cases in which he found 58 per cent in the sigmoid alone, 18 per cent in the descending colon and sigmoid, 15 per cent in the transverse colon, 5 per cent in the cecum and ascending colon and 3 per cent in the entire colon. Seventy-six per cent were found in the sigmoid colon, and in the sigmoid and other parts of the colon. My figures differ somewhat from those of either author. In my series 54, or 42.5 per cent, of the total number of cases showed diverticula confined to the sigmoid colon while in 39 cases diverticula were found in the sigmoid colon and other parts of the large intestine, making a total of 93 cases, or 73 per cent, in the sigmoid colon or sigmoid and elsewhere. In twenty-two cases the entire colon was the site of diverticula; and 52, or 41 per cent, of the cases showed diverticula in the descending colon or the descending colon and elsewhere. The diverticula in the other cases were confined to the cecum, the ascending colon, the transverse colon and the rectum or combinations of each other.

ASSOCIATED CARCINOMA AT SITE OF LESION

Spriggs and Marxer report that of the first 100 cases of diverticulitis there were no more cases of carcinoma than in the average of the hospital population. Fifield reports that among 218 cases of diverticulosis which came to autopsy there were no cases of carcinoma of the colon. Rankin stated in 1930 that among 227 cases of diverticulitis there were only 4, or 1.7 per cent, cases of carcinoma. D. F. Jones believes that cancer is associated with diverticulitis in 1.7 per cent to 8 per cent of cases.

In my group of cases only one carcinoma was found; it was located in the rectum and was associated with rectal diverticula. The percentage thus derived is 0.78 which is fairly similar to the figures of the other investigators quoted.

LESIONS OF GALL BLADDER

In Wilkinson's clinical cases eight patients, or 7 per cent, of the total number of cases were found to have cholecystitis. In order to ascertain whether or not lesions of the gall bladder were more prevalent in those with diverticulosis than those without this condition and since most of the cases of diverticulosis occur after 40 years of age, all the cases with lesions of the gall bladder over 40 years of age were studied. Of the 7000 autopsies, 3350 were over 40 years of age and of these 501, or 15 per cent, had lesions of the gall bladder. In this particular series the percentage of lesions of the gall bladder associated with diverticulosis is twice that of the percentage of lesions of the gall bladder in the 3350 cases.

PEPTIC ULCER

Similarly all cases of 41 years of age or over were reviewed to determine the incidence of peptic ulcer and 243 cases, or 7.25 per cent, were found to have suffered from this condition. Of the 120 cases of diverticulosis and diverticulitis there were eleven cases, or 9.18 per cent 41 years or over with associated peptic ulcers. The percentages in each group are quite similar. In studying only duodenal ulcers, Wilkinson found sixteen cases, or 14 per cent, associated with this pathological condition.

ESSENTIAL HYPERTENSION

There were 1144, or 34.1 per cent, of cases with essential hypertension over 40 years of age of which 52, or 43.33 per cent, of the total number of cases of diverticulosis were associated with diverticulosis. These figures show a 9 per cent increase of essential hypertension in patients with diverticulosis over the percentage of cases of essential hypertension found in the 3350 persons over 40 years of age. So small an increase is hardly of any significance.

OTHER FINDINGS

Of the 127 cases, 8 cases showed diverticula in the small intestine. No diverticula

were found in the stomach. Twenty-seven cases showed polyps elsewhere in the gastrointestinal tract. Eighteen carcinomas and one sarcoma situated other than in the region of the diverticula were found in the present series. No relationship could be detected between diverticula of the urinary bladder in cases showing no obstruction to the flow of urine and diverticula of the colon.

DISCUSSION OF CASES IN WHICH DIVERTICULA WERE THE ESSENTIAL PATHOLOGICAL LESIONS

All of the diverticula which had caused some fatal complication were located in the sigmoid colon. There were three males and three females. Five of these (three males and two females) were white persons over 40 years of age, the other one was a colored female 30 years old. Three of the 6 showed associated lesions of the gall bladder. Four died from perforation into the peritoneal cavity following a diverticulitis; one of these also had perforated into the urinary bladder and into the cervical canal of the uterus. Of the remaining two, one died from a diverticulitis and peridiverticulitis with adhesions; the other one died following a hemorrhage from an eroded artery in one of the diverticula.

CONCLUSION AND SUMMARY

Seven thousand consecutive autopsies were studied with regard to the incidence of diverticulosis. Of the cases over 40 years of age 3.58 per cent showed diverticulosis and 0.15 per cent showed some complication which had caused the death of the patient. After 40 years of age the incidence in the white male and colored female is approximately the same, while in the white female the incidence is over one-third again as much; in the colored male it occurs only two-thirds as often. There were only two-thirds as many colored persons with diverticula as white persons. Most of the diverticula were found in the sigmoid colon and in the sigmoid and other regions of the colon; all those which had produced complications were situated in the sigmoid colon.

The incidence of carcinoma of the colon, essential hypertension or peptic ulcer was not greater in the group of patients with diverticulosis of the colon than in the entire group studied. However, the incidence of lesions of the gall bladder in patients over 40 years of age was doubled in those with diverticula. No explanation for this is offered at the present time, but it bears out the clinical impression that a relation exists between abnormal colon function and cholecystopathy.

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CANCER OF RECTUM AND COLON*

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FROM the records of all patients with cancer of the rectum and colon admitted to the Wisconsin General Hospital, certain factors indicative of the current unsatisfactory state in the diagnosis and treatment of these tumors have been combined into one chart, arranged into a definite sequence reflecting the progressive course of the disease. Many other factors, such as symptoms, metastases and duration of disease, interesting in themselves, but irrelevant to this study, have been excluded. Though the chart is understandable by itself, an explanatory note about the hospital and the patients it treats, with some amplification of the brief headings, may lead to a more comprehensive interpretation.

The Wisconsin General Hospital, the teaching hospital of the University of Wisconsin Medical School, is a state institution to which the majority of patients come from all counties of the state either as total or partial charity cases. In most instances they are referred here by their local physicians. Consequently they represent in some degree a cross section of both the patients and the physicians of the entire state. Usually the local physician is a general practitioner, a fact of revealing significance. Instead of the surgeon or specialist, the general practitioner who first sees these patients and makes or fails to make the proper examination and diagnosis, still largely determines their course.

During its first eleven years in service, 60,200 patients entered this hospital; 3709 of them had cancer, using the term loosely to include all malignant tumors; and 295, or 7.9 per cent, of these patients had cancer of the rectum or colon. Of these 181 were males and 114 females; 82 per cent were between forty and seventy years of age; three patients were under 20 years of age, the youngest, a boy of 17 years, had a colloid adenocarcinoma of the rectum with widespread metastases. Incidentally the next youngest was a boy of 18 years with a colloid adenocarcinoma of the sigmoid. Four patients were over 80 years of age, the oldest a man of 83 with adenocarcinoma of the sigmoid.

The full meaning of the various headings used in the chart can best be obtained by selecting one group of patients and following their course through from the beginning. Under the heading "Rectum," for example, the first column of figures tells the story of the 117 patients with cancer of the rectum who did not come to autopsy. In the first major division of the chart, reading downwards, are tabulated the diagnoses with which these patients were referred here by their local physicians; sixty-three were referred correctly, fifteen incorrectly and thirty-nine either frankly for diagnosis or else without indication in their record whether the local physician had made a diagnosis or not.

The second major division covers certain factors in the histories obtained on entrance here. In the histories of 88 of these 117 patients, one or more of the following factors had been present: (1) tardiness on the part of the patient in seeking medical aid; (2) tardiness on the part of the local physician in making the diagnosis; and (3) inadequate early treatment regardless of diagnosis. A specific case, illustrates what is meant by these factors:

In January, 1935, the patient, a white female, aged forty-eight years, developed diarrhea and abdominal distress with intermittent periods

* From the Department of Pathology, University of Wisconsin Medical School; aided in part by a grant from the Bowman Memorial Fund for Cancer Research.

of constipation. These symptoms became progressively worse.

In April she consulted her local physician and received treatment for mucous colitis. No digital examination was made.

In July and August treatment was changed to that for amoebic dysentery.

In September a proctoscopic examination was finally done, and a diagnosis of rectal polyps was made. No biopsy was taken. Following proctoscopy, intravenous or subcutaneous treatment was started in the arm. However, by now the original pain had become so severe that

In October the patient was referred here. On entrance, the tumor was readily palpable 6 cm. from the sphincter, but in five days the patient was dead of a perforation with resultant generalized peritonitis. At autopsy the tumor measured 9 by 7 cm.

The third major division records the condition of these patients as revealed by their initial physical examination here, made routinely by the fourth year medical student and checked by the interne and resident. In 102 of these 117 patients the primary rectal cancer was palpable; in 13 patients metastases were also palpable; and in 86 patients constitutional signs, such as anemia, weight loss, cachexia, were noted. It must not be inferred, of course, that palpation alone sufficed to establish the diagnosis.

The last major division indicates the nature of the treatment it was possible to accord these patients here. In only 53 of the rectal cases was a definite attempt made to remove the cancer. Again it must not be inferred that the attempt succeeded, merely that it was made. In 64 cases only palliative measures were possible.

Though the fact is not recorded in the chart, only 43 of the entire group of 295 patients of all types had received any previous surgical, radium, or *x*-ray treatment.

CANCER OF THE RECTUM AND COLON—WISCONSIN GENERAL HOSPITAL—OCT. 1924–OCT. 1935

Location of Cancers	Rectum		R. S. Junction and Sigmoid		Colon		Cecum		
Nature of Cases	Clinical	Autopsy	Clinical	Autopsy	Clinical	Autopsy	Clinical	Autopsy	Total
Number of Cases	117	46	60	6	27	16	17	6	295
How referred here:									
Correctly as cancer	63	20	19	3	3	5	9	3	125
Incorrectly as something else	15	10	11	2	8	4	2	1	53
For diagnosis, or unknown	39	16	30	1	16	7	6	2	117
Entrance history showing:									
Tardiness in seeking medical aid, and/or									
Tardiness in early diagnosis, and/or									
Inadequate early treatment	88	36	42	4	16	10	15	5	216
Entrance condition showing:									
Primary cancer palpable	102	32	10	4	10	8	11	3	180
Metastasis palpable	13	8	2	1	0	1	2	1	28
Anemia, weight loss, cachexia	86	31	34	5	18	10	14	3	201
Nature of treatment possible:									
Radical—attempt to cure	53	12	11	1	11	8	11	3	110
Palliative—medical or surgical	64	31	25	4	11	8	6	1	150*

*Treatment of remaining 35 cases: left or died before treatment 8, refused treatment 10, here for diagnosis only 14, miscellaneous 3.

DISCUSSION AND SUMMARY

Next to ignorance of its cause, tardiness remains the greatest obstacle in combating cancer of the rectum and colon. Tardiness

may involve the patient, the physician, or the cancer itself. In the mind of the average patient, cancer still manifests itself more as a visible or palpable growth than as an impaired function. He is not apt to connect it with a mere change in bowel habit. Consequently he is tardy in seeking medical aid. His physician may neglect making a digital examination, and be tardy in diagnosis. Again, the cancer itself, by its failure to cause pain early, may be responsible for the tardiness. When it is recalled that cancer of the rectum and colon often grows slowly and metastasizes late, the record of these 295 cases seems even more distressing.

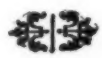
A few of the principal tabulations set forth in the chart may be mentioned briefly:

1. Of the 295 cases of all types, only 125 were referred here with the correct diagnosis, although the tumor was palpable in 180 cases, and constitutional signs present in 201. In 216 cases, one or more of the following factors had been present: tardiness in seeking aid, tardiness in early diagnosis, and inadequate early treatment. Of these three factors, tardiness in diagnosis occurred most frequently.

2. Of the 163 cases of rectal cancer, only 83 were referred here with the correct diagnosis although the tumor was within reach of the index finger in 134 cases.

3. With one exception no appreciable difference was found between the records of clinical (morbidity) groups and autopsy (mortality) groups, although one might reasonably expect the former to be less distressing. The one exception lay in the number of radical operations in the two groups with cancer of the rectum: relatively more attempts to cure were made in the clinical than in the autopsy group.

4. Patients with cancer of the cecum established a number of interesting records. They entered here with relatively the greatest number of (1) Previous operations (usually for appendicitis) (2) correct diagnoses (usually because of the attempted appendectomies), and (3) histories revealing tardy diagnoses or inadequate early treatment. However they were the only group of patients on whom radical surgery (attempt to cure) was possible here in more than 50 per cent of the cases.



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* *Continued from p. 436.*

TREATMENT OF APPENDICITIS*

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TODAY appendicitis is both the best and yet often the poorest treated surgical disease of our daily practice. During the past five years approximately eleven hundred articles have appeared in the medical literature upon this subject. I shall not attempt to review this large amount of valuable data, but it will be my purpose to indicate briefly the accepted views concerning the proper management of appendicitis in the light of these contributions.

The incidence of appendicitis has steadily increased during the past twenty years throughout the civilized world. Two factors are chiefly responsible for this: increasing accuracy in the early clinical recognition of appendicitis and an ever increasing more highly artificial, so-called "civilized," method of living.

Accompanying this increase in incidence is a steadily increasing death rate following the surgical treatment of this disease. This increase in postoperative mortality has lead to the erroneous hypothesis that this condition can be more successfully treated by the medical practitioner and that he in turn can more safely decide when surgical consultation should be requested. No physician, no matter how skilled he may be, can prognosticate in every instance as to the exact stage of the disease process present in the appendix at any given moment. Appendicitis is always a surgical problem from the instant its presence is suspected by the physician. Then is the proper time to request surgical consultation, not some six to eighteen hours later. In the case of suspected appendicitis in children, pediatric consultation should be immediately requested, if available. The promiscuous self catharsis practiced at home by the laity in an effort to self treat the so-called case of "indigestion" has filled more graves than all the wars in which this nation has been engaged. Druggists should never supply nor advise the use of catharsis to persons applying to them for a remedy for their "upset stomach." These individuals should be urged by the pharmacist to immediately consult their own doctor and let him decide whether a laxative is indicated.

Another cause for the increasing death rate in appendicitis is the false impression held by many practitioners that anyone can safely perform an appendectomy. Thus, the occasional operator firmly believes that he can at least remove the appendix. This was the concept that he obtained during his medical education and in his intern year. This fallacy was largely fostered by members of the attending staff who viewed cases of appendicitis with indifference. The occasional operator should not attempt to perform an appendectomy unless he is fully able to cope with any surgical condition that he may encounter in the abdominal cavity. The mortality from appendectomies so operated upon is at least eight times that obtained by the competent surgeon. Morphine should never be administered to the appendicitis patient until the surgeon has seen the individual and has arrived at a diagnosis. So often morphine so completely masks the signs and symptoms of appendicitis, that the diagnosis was rendered either very difficult or even impossible upon the prevailing signs and symptoms when first seen by the consultant. As was so often stressed by the pioneer surgeons in this field, the diagnosis

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of appendicitis carries with it the obligation of immediate surgery regardless of the time of day or the presence of important social events. In this last regard, many surgeons have been at fault in the past. This generation of surgeons have largely neglected the salient teachings of McBurney, Ochsner, Murphy and Deaver. Even today with vast improvement in surgical equipment and technique, many of our individual mortality rates from appendicitis are as high as those who pioneered in the treatment of this disease. Large series have shown that delay of more than twenty-four hours after the initial onset of signs and symptoms, increases the mortality rate 600 to 800 per cent.

Age is a most important factor in determining the proper treatment to be used. Those past the age of forty years have been found to be ten times more liable to die following the same treatment as that used on younger patients. Thus, in this group of elderly individuals, the proper surgical treatment will consist of doing just as little as is possible to insure the successful outcome of the case. In children under 10 years of age, the impression has been gained that they do not tolerate surgery well. This is wrong, as the young child, given the same skillful consideration and treatment as the young adult, will withstand surgical therapy better and make a more prompt recovery. Therefore, temporizing measures in children during the early stages of appendicitis should never be suggested. Seventy-five per cent of cases of appendicitis occur before the age of thirty years. No age is exempt from this malady. The older the individual, usually the more atypical are the signs and symptoms and the more prompt will be gangrene, perforation and the onset of generalized peritonitis.

Sex variation is of interest. More cases occur in males. However, females withstand the ravages and complications of appendicitis better and a greater percentage recover.

Appendicitis appears to be largely a disease of civilization or of those peoples who have forsaken their former simpler methods of living to adopt the "white-man's" standard of diet and comfort. Races that are chiefly "meat-eaters" have a higher incidence of appendicitis than those races that are chiefly vegetarian. Thus, today appendicitis is largely a disease of the white race which has evolved highly complex artificial methods of existence.

Predisposing factors in the causation of appendicitis may be any of the following: previous acute attacks of appendicitis that have damaged the appendix; fecoliths and foreign bodies in the appendiceal lumen; association with or following virulent upper respiratory infections as tonsillitis, scarlet fever and influenza; extensive adhesions of either congenital or acquired inflammatory character; dietary indiscretions and overeating; foci of infection; polyps and tumors of the appendix whether benign or malignant; hereditary weakness towards appendicitis; unusual physical exertion; trauma to the anterior abdominal wall; various types of gastroenteritis; abnormal positions of the appendix; pelvic disease; male sex and youth.

For purposes of this discourse, appendicitis may be classified as follows: chronic, interval, secondary to other abdominal surgery, acute, acute-gangrenous, and acute perforated appendicitis. In the first three groups the previously mentioned principles are true and the mortality rate should be zero. Postoperative deaths are usually due to faulty technique on the part of the surgeon and the burden of proof rests squarely upon his shoulders of proving that such was not the case. Caution must be exercised to be certain that the patient is really suffering from a diseased appendix. It has been shown that at least 35 per cent of these cases have had a purposeless appendectomy performed, because they had not been thoroughly studied and some other disease was responsible for their abdominal complaints. Some of these diseases to be

differentiated are: pneumonia; influenza; central nervous system lesions; abdominal crises of tabes dorsalis and purpura hemorrhagica; herpes zoster; lead colic; scarlet fever; measles; typhoid fever; pneumococcic and tuberculous peritonitis; hypertrophic spinal arthritis; acute gastroenteritis; parasitic disease of the gastrointestinal tract; perforated peptic ulcer; acute pancreatitis; acute cholecystitis; mesenteric lymph adenitis; Meckel's diverticulitis; diverticulitis of the colon; polyps and benign or malignant tumors of the gastrointestinal tract; intestinal obstruction; volvulus; intussusception; right sided pyelitis; right ureteral calculus; right epididymitis; pelvic inflammatory disease; twisted right ovarian pedicle; ruptured right ovarian cyst; ruptured or nonruptured right ectopic pregnancy; etc. In these first three groups an incision through the medial third of the right rectus muscle or a low midline abdominal incision should be made to insure complete exploration at the time of surgery.

Much has been written concerning the fallacy of making a diagnosis of chronic appendicitis. Some authors deny the existence of such a clinical entity and maintain that really all that one sees represent the end products of a healing or healed previous acute appendicitis. There is now considerable clinical evidence to show that in the carefully studied case in which all other conditions that may simulate appendicitis have been ruled out, such appendices when removed have resulted in a high percentage of clinical cures. Pathologically, it seems futile to argue that changes similar to those commonly described for chronic appendicitis are in reality of no consequence, but that similar histological pictures presented elsewhere in the gastrointestinal tract and in the human body are pathognomonic of undoubted chronic inflammation.

In acute appendicitis and in acute gangrenous appendicitis, which form the large majority of cases with which we are really concerned in this discussion, immediate appendectomy without delay will always remain as the only proper treatment. If the diagnosis is clear cut, some type of muscle splitting incision in the right lower quadrant of the abdomen is the approach of choice. However, if there exists any doubt as to the cause of the acute abdomen and particularly in women, far fewer mistakes will be made and an equally low mortality will be obtained, if a low right rectus incision is made. In dealing with instances of acute and acute gangrenous appendicitis, experience has shown that they must be removed under direct vision and never by blind blunt dissection, in order to prevent their rupture during delivery and for the purpose of obtaining accurate, thorough hemostasis. This thus entails the making of an adequately large incision. It is usually only the inexperienced or careless operator who will purposely place his patient's life in jeopardy by trying to remove an appendix of this character through a "button-hole" incision. Incisions heal from side to side and not from end to end. In making the muscle splitting incision, scrupulous attention must be paid to the preservation of the ilioinguinal and the iliohypogastric nerves, because injury to them leads to a subsequent diffuse weakness of the entire abdominal wall in the right lower quadrant with the development of a large postoperative ventral herniation. Monk's appendix containing forcep is of inestimable value in these cases. The appendix, as soon as freed from its mesoappendix and down to the appendicocecal juncture, is placed within this hollow forcep and then the patient is safeguarded from the accidental rupture of the appendix during the course of its subsequent handling in preparation for its removal. In making a right rectus incision, the muscle should only be split in the direction of its fibers in its medial third so as to preserve the nerve supply which enters along its lateral border. An incision through the lateral or middle third of the rectus muscle usually does considerable damage to the muscle for the extent of the incision and advertises that this was the handiwork of either

an ignorant or careless surgeon. Recent studies have shown that the muscle splitting incision carries one-half as much mortality as the low right rectus approach, probably because the former incision prevents excessive handling of the small intestine and exposure of the general peritoneal cavity.

The treatment of cases of acute perforated appendicitis taxes the skill and sound surgical judgment of the surgeon to the utmost. This group has always carried the highest surgical mortality of all types of appendicitis, largely because of the onset of generalized peritonitis due either to the failure of the abdominal contents to wall off a perforated appendix successfully early enough or to illadvised meddlesome surgery at an improper stage in the disease process. Formerly this type of appendicitis possessed a death rate of about 40 per cent. With skillful handling, this mortality should be reduced to less than 10 per cent. In this type, the muscle splitting incision is the approach "par excellence" and an effort should be made to approach the cecum by a laterally placed incision in the right lower quadrant, so as to reach the head of the cecum extraperitoneally and to avoid exposing either the small bowel or to break up adhesions already formed which have partially walled off this area from the general peritoneal cavity. If the appendix can be removed with ease and without breaking down protective adhesions or abscess walls, it may be done; otherwise, only simple but thorough drainage is indicated. These patients may return two or three months after their dismissal from the hospital for a subsequent appendectomy which then only carries little more operative risk than the interval case.

The muscle-splitting incision has other points upon which to recommend itself in this class of cases, because it is the most advantageously placed approach for satisfactory drainage and also because there is very little danger of evisceration or herniation following extensive wound infection. If a right rectus incision has been made and an appendiceal abscess is encountered in the right iliac fossa, that incision should be closed without disturbing the appendix. Then a muscle splitting incision should be immediately made over the abscess site and proper drainage instituted. Never should an appendiceal abscess be drained across the clean peritoneal cavity nor should protective adhesions be broken down so as to remove the appendix through the right rectus approach. Operative management of this character is accompanied by quite formidable mortality.

The closure of an infected drained muscle splitting incision should only entail the tight closure of the peritoneum about the drains; while the various muscle layers are not resutured and only several retention sutures are placed through the skin and into the external oblique aponeurosis to obliterate dead spaces in the wound. The skin edges may be loosely approximated by either interrupted dermol skin sutures or by a few skin clips. Additional suturing of the layers of the incision will only lead to their extensive necrosis and sloughing. Only soft rubber dam tubular Penrose drains without gauze wicks should be employed for purposes of drainage. Even these soft pliable drains in the presence of extensive wound infections may occasionally erode into neighboring blood vessels. In infected incisions of this character, early adequate drainage must be assured so that pocketing does not occur. The best results are obtained by leaving these wounds wide open and allowing them to heal from the bottom outwards.

In instances of generalized diffuse peritonitis, drainage should involve the ileocecal area, the right iliac fossa, along the right colic gutter, and towards the left pelvis. In selected cases, drains may be advantageously brought out through small stab wounds in the flanks. These drains should be slowly removed over a period of ten to eighteen days, so as to establish a sinus tract to the outside through the incision. Such drains should never be removed during the first few days postoperatively.

Occasionally in this group, exploration will reveal a large appendiceal perforation through which is continually pouring fecal content. In such a situation, a ligature should be passed proximal to the perforation and tied, regardless of whether it is safe to remove the distal portion of the appendix at that time. This type of appendicitis requires the performance of quick, gentle, atraumatic surgery. Never should extensive tedious surgery be attempted as such ill-advised operative treatment increases the postoperative mortality by 300 per cent or more over that of simple drainage. I do not invert the appendiceal stump.

Much has been written concerning the advisability of employing the Ochsner or Sherrin methods of treatment in cases that have had signs and symptoms of longer duration than forty-eight hours. This method of conservative treatment is only advisable in that particular group of patients who are already improving when first seen by the surgeon and they possess a palpable mass in the right lower quadrant of the abdomen. However, in instances of uncontrolled spreading peritonitis, in which the patient is steadily growing worse, a quick extraperitoneal approach to the ileocecal region with the establishment of adequate drainage is definitely indicated.

In acute appendicitis spinal anesthesia still remains the anesthetic of choice as it prevents excessive straining of the intestinal coils and thus minimizes the spread of peritonitis or the production of a paralytic ileus. In children and in the aged, general anesthesia is still indicated. Nitrous oxide, ethylene or ether may be safely used and give fairly good muscular relaxation.

The safest course to follow in the postoperative treatment of all cases of appendicitis is to allow nothing by mouth until the patient is able to pass flatus freely per rectum accompanied by the subsidence of fever, nausea and abdominal distention and pain. In the interval before these events occur, fluids may be administered either by hypodermoclysis or by the intravenous route, in sufficient amount to prevent dehydration and to maintain the glycogen reserve in the liver. For this purpose 10 per cent glucose solution in normal saline in amounts of 2000 c.c. per day intravenously has been found quite satisfactory. Proctoclysis is definitely contraindicated. Hot massive abdominal stupes, dry heat to the abdomen by means of electric lamps, full Fowler's position, and sufficient opiates to insure gastrointestinal rest are still invaluable adjuncts to the successful care of these patients who possess appendiceal abscesses or generalized peritonitis originating from the appendix. Weinberg's peritonitis vaccine, peritonitis bacteriophage, non-specific protein therapy, and Handley's jejunocolostomy are of value in selected instances and have saved many lives. Calcium gluconate, pitressin and prostigmin-prophylactic have proved of great value in the smooth postoperative handling of many of these cases.

Elevation of the foot of the bed during the first postoperative day, unless contraindicated by the presence of a generalized peritonitis; the use of "carbogen" inhalations during the first three postoperative days; the frequent changing of the patient's position in bed; and frequent mouth rinsings with an oral antiseptic have lessened the incidence of postoperative pulmonary complications. Heat to the extremities; passive and active moving about of the lower extremities; the avoidance of pillows beneath the knees; and the intelligent care of the infected incision have greatly reduced the incidence of femoral and iliac thromboses and the more dread complication of pulmonary embolism. If pulmonary embolism should occur, many cases may be saved by the immediate administration of one ampoule of spasmalgin intravenously, which contains papavarine hydrochloride. Other cases may not react favorably to this treatment and may fail to improve. In these instances, the Trendelenburg operation upon the pulmonary artery should be promptly performed and should also include the

ligation of the vena cava well caudad to the entrance of the renal veins, so as to prevent subsequent embolisms arising from the lower extremities.

The secondary formation of abscesses elsewhere in the abdominal cavity requires constant vigilance so as to promptly recognize and to institute proper methods and approaches for their drainage, as soon as they can be reached without soiling the rest of the peritoneal cavity.

The problem of when to drain a case of appendicitis has now simplified itself to the case in which we are dealing with a frank abscess. Instances of acute gangrenous appendicitis with only a localized or beginning peritonitis do far better if the peritoneal cavity is not drained. However, in these cases, the incision should be drained from the peritoneum outwards by a small Penrose drain brought out the most dependent portion of the incision.

CONCLUSIONS

1. Appendicitis is always a surgical problem requiring immediate surgical consultation.

2. The diagnosis of appendicitis requires immediate surgery without delay, except in certain neglected instances that are already showing signs of improvement and possess a definite palpable lower abdominal mass.

3. Administration of morphine prior to surgical consultation is to be condemned.

4. Catharsis can not be denounced too strongly, as it has killed more individuals suffering from appendicitis than all the wars in which this Nation has been engaged.

5. Appendectomies by the occasional operator have led to a definite increase in their mortality, as compared to the results obtained by the competent surgeon.

6. Increased age, delay in operating beyond twenty-four hours following the onset of symptoms of appendicitis, mistaken diagnoses, improperly made incisions, ill advised extensive surgical procedures in gangrenous or perforative appendicitis and in the aged, failure to drain the diseased region properly, poorly advised temporizing measures, and faulty postoperative management have been important factors in increasing the excessive present day mortality in appendicitis.

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ACUTE APPENDICITIS IN CHILDHOOD*

A STUDY OF THE CASES TREATED IN THE CHILDREN'S WARD OF THE DUKE HOSPITAL DURING THE PERIOD 1930–1935 INCLUSIVE

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IN a review of all cases of acute appendicitis admitted over a period of five years to the Duke Hospital the mortality rate in children under 15 years of age was found to be more than twice that in adults. All the cases admitted to the children's ward during this period, with a tentative or definite diagnosis of acute appendicitis therefore were reviewed with the hope of clarifying the problem of diagnosis as well as learning the more important factors governing the mortality rate and drawing some conclusions as to the most effective method of treating the extremely ill patients. During the five year period covered in this report 202 children under 15 years of age were admitted with the diagnosis of acute appendicitis. In the same interval forty-nine children sent to the hospital by their family physicians with the diagnosis of acute appendicitis were discharged without operative treatment following a decision that appendicitis was not the cause of their symptoms.

A résumé of the pathology of acute appendicitis in children is beyond the scope of this report. However, it should be remembered that children probably have less general resistance to intra-abdominal infection than adults. Also a child's thin bowel wall tends to make the incidence of perforation more frequent, and when peritonitis has developed the short omentum of childhood is much less effective in keeping the infection localized than is the larger apron of the adult.

Some appreciation of the difficulties encountered in making an accurate diagnosis of acute appendicitis in the child may be obtained from a review of the disorders for which an appendectomy was done in this series of cases (Tables 1A, B and C). The incidence of acute appendicitis in infancy is relatively low and the frequency increases proportionately throughout childhood into adolescence. In infants and children too young to cooperate with the examiner the diagnosis must rest largely on objective evidence of intestinal colic and signs of peritoneal irritation, such as tenderness on palpation of the abdomen, and possibly the demonstration of rebound tenderness. With older children the attack usually follows a pattern, the essential features of which are abdominal pain, nausea, vomiting, and tenderness over the appendix. Rebound tenderness over the appendix is a sign of especial importance and was present in over 90 per cent of the children in our series having acute appendicitis. Infrequently an attack starts with vomiting prior to any pain. In 12 per cent of our patients the abdominal pain was localized in the right lower quadrant from the onset of the attack, and did not follow the usual sequence of originating in the epigastrium or periumbilical region and later localizing in the right lower quadrant.

Although in the early stages of the disease the symptoms and signs may be very difficult to evaluate, with the progressive development of the attack they become more clear cut. When interpreting the findings in the individual patient, the changing picture of the typical case as the attack progresses should be kept constantly in mind. Usually in a child the symptoms and signs will have begun to subside or there will be evidence that the appendix has become perforated within sixty hours after the onset of symptoms.

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On the other hand in a few children the rapid development of spreading abdominal tenderness, intense rebound tenderness, and abdominal muscle spasm may indicate that the appendix has become perforated sooner than twenty-four hours after the onset of symptoms as occurred in four patients in this series. In those children who had a perforation of the appendix with a concomitant peritonitis, vomiting was a symptom consistently found and distention followed quickly. The temperature was usually elevated, whereas the leukocyte count showed a wide variation ranging from a normal count of 8000 to 43,000 cells.

The many variations in the clinical picture of acute appendicitis as well as the numerous abdominal, thoracic, and systemic disorders which simulate the disease result in numerous erroneous preoperative diagnoses. Thus, acute mesenteric lymphadenitis in this series of cases (Table IA) was the most common condition confused with acute appendicitis. The symptoms of these two disorders were found so similar that it was often difficult from the history to differentiate between them. However, 61 per cent of the cases of mesenteric lymphadenitis were accompanied by a story of previous attacks, while such a past history was obtained in only 16 per cent of the cases of acute appendicitis. Rebound tenderness, found on examination in 15 per cent of the children with mesenteric lymphadenitis was present in over 90 per cent of the patients with acute appendicitis. Fifty per cent of the patients with mesenteric lymphadenitis had a co-existing upper respiratory infection and careful examination frequently revealed a general enlargement of the lymph nodes while these findings were very infrequent in children with acute appendicitis. The dissimilarities in the clinical picture of the two disorders noted and the diagnostic acumen of the examiner were usually inadequate in a particular case to enable a differential diagnosis to be made until after the abdomen was opened.

It is often dangerous to delay appendectomy on a supposition that a child may have acute mesenteric lymphadenitis as by so doing some cases of acute appendicitis will undoubtedly be denied the benefit of timely operation. The thirty-nine children who were operated on for acute mesenteric lymphadenitis suffered no ill effect from the operation and a follow-up study of these patients showed that more than 50 per cent of them had a definite improvement in general health following appendectomy. However we do not believe that this benefit can be ascribed entirely to the operative procedure.

There were eight children in the series (Table IA) who had appendiceal colic due to obstructive lesions of the appendix. At operation in each instance the appendix was found to be obstructed by a kink, a band or a fecal concretion which had trapped gas in the lumen distal to the point of obstruction. Over 60 per cent of these patients had suffered from previous episodes of appendiceal colic and a follow-up study showed that all were relieved of their attacks of abdominal pain by operation.

There were only two children in the series who had intestinal worms in the lumen of the appendix (Table IA), although these parasites are fairly common in this immediate locality. It is questionable whether these were the cause of the patients' symptoms as each child had enlarged lymph nodes in the mesentery and the mesenteric lymphadenitis present might well have been responsible for the abdominal pain.

The two recorded cases of a Meckel's diverticulum (Table IA) showed vomiting as a prominent symptom and in each the pain and tenderness was diffuse over the lower abdomen. In one patient the entire loop of ileum from which the diverticulum arose, as well as the diverticulum itself, was gangrenous. The other child had a loop of terminal ileum obstructed by an adherent diverticulum. Both children were sent to the hospital with the diagnosis of acute appendicitis, and both were thought

TABLE IA

CHILDREN UNDER 15 YEARS OF AGE OPERATED ON WITH TENTATIVE DIAGNOSIS OF ACUTE APPENDICITIS 1930–1935

Final Diagnosis	Number of Cases	Male	Female	Abdominal Pain	Nausea	Vomiting	Previous Attacks	Catharsis	Duration of Symptoms Prior to Operation	Average Temperature	Average Leucocytes	Abdominal (RLQ) Tenderness	Rebound Tenderness	Rigidity	Rectal Tenderness or Mass	Findings on Operation Procedure		Results
Acute appendicitis. Total cases	124	76	48	124	120	113	21	68	130 hours	38	16,000	124	114	92	106	See Table IV		115 Well 9 Died
Mesenteric lymphadenitis	39	19	20	36	31	18	24	9	63 hours	37.7	14,356	35	6	17	27	Glands in mesentery Appendectomy	39 39	39 Well
Appendiceal colic	8	3	5	8	6	1	5	4	98 hours	37.7	10,700	6	5		5	Kinks, bands, fecaliths obstructing lumen Appendectomy	8 8	8 Well
Appendices with parasites	2	2		2	1	1	1		54 hours	37.8	11,000	2	1	1	2	Round worms in appendix Appendectomy	2 2	2 Well
Interval appendix	1	1		1	1	1	1		typical attack one month ago	37.8	7,000					Normal appendix Appendectomy	1	1 Well
Meckel's diverticulitis	2	2		2	2	2	1	1	42 hours	38.7	19,000	2	1	1	1	Diverticulitis Obstruction from diverticulum *Diverticulectomy*	1 1 2	2 Well

TABLE IB

CHILDREN UNDER 15 YEARS OF AGE OPERATED ON WITH TENTATIVE DIAGNOSIS OF ACUTE APPENDICITIS 1930–1935

Final Diagnosis	Number of Cases	Male	Female	Abdominal Pain	Nausea	Vomiting	Previous Attacks	Catharsis	Duration of Symptoms Prior to Operation	Average Temperature	Average Leucocytes	Abdominal (RLQ) Tenderness	Rebound Tenderness	Rigidity	Rectal Tenderness or Mass	Findings on Operation Procedure		Results
Acute salpingitis	4		4	4	3	1		4	73 hours	38.1	15,000	4	2	2	4	Acute salpingitis Appendectomy	4 4	4 Well
Pneumococcus peritonitis	2		2	2	2	2	1	1	84 hours	39.4	9,000	2	2	2	2	Peritonitis with normal appendix Appendectomy with drainage		1 Died 1 Well
Menarche	3		3	3	2		2	1	33 hours	37.1	9,700	3	2	1	1	Normal appendix Appendectomy	3 3	2 Well
Pyelitis	2		2	2	1	1	2		64 hours	38.9	21,000	2	1	1	1	Normal appendix Appendectomy	3 2	3 Well

to have intestinal obstruction by the operating surgeon.

The difficulties encountered in making the diagnosis of acute appendicitis in girls are often greater than in boys because of the frequency of pelvic lesions which mimic the clinical picture of the former disease. The similarities in the symptoms and signs presented by acute appendicitis and acute salpingitis account for the 4 cases recorded (Table IB). All of the patients were adolescent girls, a group in which acute gonococcal salpingitis is not so common as it is at a later age. In reviewing the cases it is worthwhile to note that gram negative intracellular diplococci were found in vaginal smears obtained after operation from each patient.

Pneumococcus peritonitis was found in two girls sent to the hospital and operated on with the preoperative diagnosis of acute appendicitis (Table IB). One of these, who had a diffuse peritonitis due to a pneumococcus of group IV, was the only patient who died after appendectomy who did not have acute appendicitis. This type of infection is more commonly found in girls under 10 years of age. In addition to the abdominal pain, nausea, vomiting and distention accompanied by abdominal tenderness found in the severe cases, the patients frequently have diarrhea and frequency of micturition with dysuria. Profound prostration develops early and the peritonitis beginning in the pelvis often becomes generalized. Organisms can often be demonstrated in the vaginal discharge as was done in the two cases in this series, after operation had shown the true intra-abdominal condition. Conservative supportive treatment until the peritonitis has localized and then institution of drainage is widely advocated when the diagnosis can be made before an operation is performed. Antipneumococcus serum has been used with varying success. With any form of therapy the incidence of mortality in the disease is high, ranging from 40 to 90 per cent.

Three adolescent girls developed acute lower abdominal symptoms prior to the onset of menstruation (Table IB). One at operation showed blood exuding from the fimbriated ends of the tubes and the normal menstrual flow began the next day. The other two also had normal appendices and began to menstruate for the first time on the day following operation.

Two cases of pyelitis (Table IB) which were operated upon as acute appendicitis was suspected, showed little in the urine on admission but on examination of the urine twenty-four hours later many pus cells were found. A child with pyelitis usually has tenderness over the kidney, however occasionally the pyuria may be masked by a ureteral obstruction and the urine may be negative at the initial examination.

There are a large number of systemic disorders giving rise to abdominal symptoms in childhood which may result in the erroneous diagnosis of acute appendicitis. A few of these were encountered in this series of cases and are recorded in Table IC. Six children had acute attacks of abdominal pain with upper respiratory infections that varied from a coryza to a moderately severe bronchitis. At operation each of these patients had a normal appendix. Two of them developed a bronchopneumonia during their postoperative convalescence. There seems to be no definite symptom complex by which these cases may be recognized and as one not infrequently encounters acute appendicitis in a child with an upper respiratory infection it may be wiser under these circumstances to remove a normal appendix and to err on the side of safety. When confronted by this problem the opinion of a pediatrician or of a medical consultant, and an *x*-ray examination of the chest, may help avoid an operation which would be definitely harmful. By following this procedure, patients with lobar pneumonia with abdominal manifestations, which would otherwise be diagnosed as acute appendicitis, may be recognized, and operation avoided. Hiatt has tabulated the outstanding differ-

TABLE IC

CHILDREN UNDER 15 YEARS OF AGE OPERATED ON WITH TENTATIVE DIAGNOSIS OF ACUTE APPENDICITIS 1930–1935

Final Diagnosis	Number of Cases	Male	Female	Abdominal Pain	Nausea	Vomiting	Previous Attacks	Catharsis	Duration of Symptoms Prior to Operation	Average Temperature	Average Leucocytes	Abdominal (RLQ) Tenderness	Rebound Tenderness	Rigidity	Rectal Tenderness or Mass	Findings on Operation Procedure		Results
Abdominal pain with upper respiratory infection.	6	2	4	6	5	2	2	3	106 hours	37.8	10,000	6	3	3	2	Normal appendix Appendectomy	6 6	6 Well
Abdominal pain Cause Undetermined	5	1	4	5	2	2	2	1	80 hours	37.7	11,000	5	4	3	3	Normal appendix Appendectomy	5 5	5 Well
Rheumatic fever	1		1	1	1	1	1		6 hours	37.6	19,000	1	1	1	1	Normal appendix Appendectomy	1 1	1 Well
Catarrhal jaundice	1	1	1	1	1	1	1	1	31 hours	39.4	9,000	1	1	1	1	Normal appendix Appendectomy	1 1	1 Well
Pleurodynia	1	1		1	1	1	1		96 hours	37.4	6,000				1	Normal appendix Appendectomy	1 1	1 Well
Gastroenteritis	1	1		1	1	1	1		216 hours	38.4	11,000					Normal appendix Appendectomy	1 1	1 Well
Total Tables IA, B, C	202	108	94															

ences in the symptoms and signs of the two conditions (Table II).

The final diagnoses of the remaining cases tabulated in this group (Table IC) are self-explanatory. Five children who had normal appendices removed were listed on the case histories as having intra-abdominal pain of undetermined origin. The clinical picture each presented prior to operation was entirely consistent with the diagnosis of acute appendicitis. All were diagnosed as acute appendicitis, but who were not operated on (Table III). The personal element which cannot be reduced to figures was undoubtedly a large factor in determining the treatment that individual case received. The children who were operated on, and also those who were not, were under the direct care of one of a group of twelve surgeons.

In reviewing the cases of acute appendicitis (Table IV) we find that duration of

TABLE II

DIFFERENTIAL DIAGNOSIS OF PNEUMONIA AND APPENDICITIS

	Pneumonia	*Appendicitis*
History	Previous cold or cough; chest pains	Exceptionally grip
Abdominal pain	Severe, constant general	Paroxysmal, less intense, local
Vomiting	14%	70%
Diarrhea	Common	Uncommon
Facies	Looks ill, dilatation of ala nasi; flushed	Pale
Respiratory symptoms	Shallow abdominal breathing; expiratory grunt; maybe dullness and tubular breathing	Shallow breathing Costal breathing
Abdominal tenderness	Superficial, severe, diffuse, usually high in abdomen. No worse on deep pressure	Slight or severe; more marked on deep pressure—local
Rectal	Negative	Tenderness on right
X-ray	Positive	Negative
Leucocytes	20 to 50 thousand	10 to 20 thousand
Temperature	103 to 105	98.6 to 102
Attitude	Irritable and restless	Lies quietly

(Hiatt, H. B. *South. Med. and Surg.*, 1930.)

relieved of their symptoms by operation although no specific cause for their complaints was demonstrated at that time or by studies afterward. Still another girl who had an appendectomy six hours after the onset of what seemed to be a typical attack developed, within forty-eight hours after operation, swollen, painful joints, and later evidence of rheumatic heart disease. A child who had pleurodynia was operated on before an epidemic of that disease in the neighborhood was recognized. One patient with gastroenteritis had an appendectomy because it was suspected that he was having bouts of appendiceal colic.

The same diagnostic problems summarized in the foregoing paragraphs were encountered in the forty-nine children who were sent to the hospital having been

symptoms prior to operation is the most important single factor which influences the mortality rate of acute appendicitis and both the parent and the physician should use every effort to achieve early recognition of the condition. When operation is performed before perforation, it is attended by little or no risk and the mortality rate should be nil. Catharsis apparently is a definitely harmful factor in the cases of perforation. This may be due to the increased peristalsis induced by the drug or the result of the parent's wish to wait until the cathartic takes effect before bringing the child to the physician. Undoubtedly when an appendix is in the process of becoming perforated, increased peristalsis due to cathartic action tends to spread an infection which might otherwise remain localized.

TABLE III

CHILDREN UNDER 15 YEARS OF AGE SENT TO DUKE HOSPITAL WITH TENTATIVE DIAGNOSIS OF ACUTE APPENDICITIS NOT OPERATED ON 1930–1935

Final Diagnosis	Number of Cases	Male	Female	Abd. Pain	Nausea	Vomiting	Previous Attacks	Cathartics	Duration of Symptoms before Admission in Hrs.	Average Temperature	Average W. B. C.	Abdominal Tenderness	Rebound Tenderness	Rigidity	Rectal Tenderness	Accessory Findings of Note on Admission
Abdominal Pain with Chronic Tonsillitis.	10	2	8	10	5	5	4	5	60	37.6	10,000	4	2	3	1	Upper Respiratory Infection
Mesenteric Lymphadenitis	9	3	6	9	5	2	3	1	128	37.8	8,200	7	3	2	2	General Lymph Node Enlargement. Chronic or Subacute Tonsillitis
Abdominal Pain Cause Undetermined	8	1	7	8	1	1	4	3	85	37.5	8,500	4	3	2	2	
Gastroenteritis	7	4	3	7	6	6	4	4	48	37.8	10,000	4	2	1	2	Coryza. Dietary Indiscretion
Pneumonia	4	3	1	4	3	3		3	36	40	23,000	3		1		Coryza, Pharyngitis, Productive Cough, Varied Chest Findings
Pleurodynia	3	3		3	2	1	1	1	49	38.3	6,000	1	1			Mild Upper Respiratory Infection
Salpingitis Acute	2		2	2	2	2	1	1	60	39.5	24,000	2	2	1	2	
Ankylostomiasis	2		2	2	1		1	1	228	37.5	11,000	1				Stools showed Necator Americanus
Duodenal Ulcer	1	1		1	1	1	1	1	120	37.8	18,000	1				X-ray showed Duodenal Ulcer
Dysmenorrhoea	1		1	1			1		1	37.8	15,000					
Menarche	1		1	1	1	1			168	37	8,000					Menses Started 48 hrs. after Onset of Pain
Pyelitis	1		1	1	1		1		72	38	9,000	1				Urine Negative on Admission. Showed many W. B. C. the Next Day

Eight children admitted after the appendix had ruptured and peritonitis had developed, were treated conservatively. One infant died undiagnosed twenty-four hours after entry. On admission he was thought to have pneumonia but autopsy showed a ruptured appendix with generalized peritonitis. The seven remaining children were treated by the "Ochsner-Sherron" method until the inflammatory process had completely resolved, and all recovered. At the time of admission four patients had well circumscribed pelvic abscesses which were recognized only by rectal examination; two had abscesses in the lower abdomen; and one had a diffuse pelvic peritonitis. We do not believe that definite conclusions can be drawn from such a small group but record the usefulness of this method in these well selected, carefully watched patients. Other authors decry the use of this method of treatment in children.

TABLE IV

CHILDREN UNDER 15 YEARS OF AGE ADMITTED TO HOSPITAL WITH ACUTE APPENDICITIS

Condition Found at Operation	Number of Cases	Duration of Symptoms Prior to Operation	Cases Receiving Cathartics before Operation, Per Cent	Treatment		Results	Mortality, Per Cent
Acute Appendicitis (Unruptured)	67	33 hours	34.3	Appendectomy	67	67 Well	
Acute Appendicitis Perforated with Abscess	31	131 hours	80.6	Appendectomy & Drainage Drainage Alone Conservative (No Operation)	21 4 6	21 Well 4 Well 6 Well	
Acute Appendicitis Perforated with Pelvic Peritonitis	13	70 hours	76.9	Appendectomy & Drainage Drainage Alone Conservative (No Operation)	10 2 1	10 Well 2 Died 1 Well	15.3
Acute Appendicitis Perforated with General Peritonitis	13	88 hours	84.6	Appendectomy & Drainage Drainage Alone Conservative (No Operation)	11 1 1	(6 Well (5 Died 1 Well 1 Died	53.8
Total.....	124	67.1 hour average				115 Well 9 Died	7.8

The outstanding fact learned in studying acutely ill cases is that an emergency operation on a dehydrated child, suffering from pelvic peritonitis or generalized peritonitis is of little therapeutic value. The child who is in acidosis and has an extensive abdominal infection cannot be saved by any emergency operation. These children certainly should be treated in full Fowler's position, with intravenous fluids until their acid base balances have been restored and the dehydration has been corrected. During the same time the adynamic ileus can be combatted by gastric siphonage and by enemas. It may be wise to treat them conservatively for a period of twenty-four to forty-eight hours or longer if they continue to improve under a regime of intravenous fluids and transfusions. When operation is done it should be limited to simple drainage unless the appendix can be removed with minimal trauma and without prolongation of the anesthesia.

All the cases reported here were operated on through a McBurney incision and in the majority the anesthesia was nitrous

oxide and oxygen. A few cases were operated on under drop ether anesthesia.

SUMMARY

The data obtained from a study of 202 children fourteen years of age and younger admitted to Duke Hospital with a diagnosis of acute appendicitis, are presented. A review of the cases emphasizes the variety of the diagnostic problems presented by the child with abdominal pain. No child in this series died who was seen by the surgeon within twenty-four hours of the onset of the attack, and we believe that any child who has persistent abdominal pain for six hours should be considered as having an acute intra-abdominal condition. With Lord Moynihan we deplore the "philocathartic propensities" of parents and note also that opiates in children, as well as in adults, should not be given to relieve abdominal pain until after the diagnosis of the intra-abdominal condition has been made by the physician who is to carry the treatment to its conclusion. Emergency operations should not be done on children who have a widespread peritonitis until dehydration and acidosis have been corrected. The timely opinion of an able pediatric or medical consultant may help clarify a difficult diagnosis and avoid an unnecessary operation.

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BURSITIS*

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MUCH has been written concerning the diseases of bursa, but little was known about their development until recent studies of these structures. These studies have fairly definitely pointed out that bursa are potential spaces developed in connective tissues. They contain a synovial-like fluid which permits movement of one tissue over another with a minimum of friction. It has been shown very definitely that bursa are developmental in origin and that they appear in the connective tissue in response to a functional demand. In 1934, Black[1] examined a large number of fetuses and showed that only the subacromial bursa was present at birth and this he was able to identify as such in 72.5 per cent of the specimens. Neither the commonly found subcutaneous olecranon nor the prepatellar bursa was present at birth. Therefore, one is forced to the conclusion that they develop after birth in response to movement. One could conceive this development as prolongation and fusion of the intercellular spaces in the plane of motion, the bursal space itself representing an intercellular space between layers of connective tissue cells, with the bursal fluid as liquid intercellular matrix.

Cells of bursa and tendon sheaths do not differ in any marked degree from those of joint synovial membrane, and a joint cavity, according to recent studies of the cell structure, appears to be a local modification of a specialized connective tissue, the synovia, in which the intercellular matrix is very fluid.[2]

In the formation of the subacromial bursa as followed in fetuses, Black[1] states that

> connective tissue of a fairly circumscribed area undergoes certain changes to form a fairly definite anlage composed of large moderately closely packed cells which are arranged more or less parallel to the long axis of the future bursa. Slits appear between the cells and merge or remain adjacent. These slits extend throughout the bursal anlage, but stop at the border of the undifferentiated connective tissue.
>
> The early slits develop into a definite cavity lined by swollen characteristic cells. When the cavity attains a certain size, the lining cells disappear, and the cavity comes to have a lining of ordinary, but specially arranged, fibroblasts and other connective tissue elements.

Trabecula seen in otherwise normal bursa may then be regarded as simply intervening septums or folds between bursal slits in the same plane, which have not undergone fusion, and not necessarily as pathological adhesions between apposed surfaces.

For convenience in study, bursa may be divided into two groups, the superficial and the deep. Superficial bursa are those which lie in the connective tissue between the skin and bony prominences. Those which most often are found to produce symptoms are the olecranon, prepatellar, and the bursa over the head of the metatarsophalangeal joint of the great toe. The deep bursa are those which lie between muscle and moving bony points. The most important of these is the subacromial or subdeltoid bursa; less often the bursa over the greater trochanter of the femur or over the tuberosity of the ischium may give symptoms.

DISEASES OF THE SUPERFICIAL BURSA

Superficial bursa, those which develop in response to long continued or repeated friction between the skin and bony parts, may assume definite pathological changes due to trauma or infection.

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Acute Traumatic Bursitis. Ordinarily, application of external violence over a superficial bursa, for example the olecranon

FIG. 1. Acute traumatic olecranon bursitis.

bursa, results in sliding of the skin over the triceps tendon and olecranon process. If, however, the violence is such that contusion or tearing of the bursal surface occurs, hemorrhage and exudation take place. The bursa, previously only a potential space, fills with serosanguineous fluid and becomes a palpable, well defined, fluctuant sac over the point of the elbow (Fig. 1). From a distended bursa a characteristic viscid bloody or, later, straw colored fluid may be aspirated.

The fluid tends to be absorbed when the acute reaction subsides, but varying amounts of cellular elements and fibrin remain and undergo organization. This results in thickening and roughening of the bursal wall, and perhaps adhesions between apposed bursal surfaces. After a single trauma the residual thickening may be so slight as to cause no palpable changes. Persistent return of fluid into the bursal space following an acute bursitis probably is due to friction between the apposed roughened surfaces on return to motion.

The symptoms of acute traumatic bursitis are easily recognized. There is a history of a trauma applied to the affected bursa with subsequent appearance of tenderness and distention of the bursal sac. It is somewhat important in making the diagnosis to ascertain whether the lesion is an acute traumatic bursitis superimposed upon a chronic process, or whether the trauma has been applied to an otherwise normal bursa. It is important to make this differential diagnosis because of the difference of prognosis and of treatment. An acute traumatic lesion in a previously normal bursa is treated like any acute traumatic lesion. Immobilization of the part prevents further injury, decreases pain and makes for early subsidence of the acute symptoms. The internal right angle splint for olecranon, and the posterior knee splint for prepatellar bursitis, serve very well. A firm elastic compression bandage applied to the part tends to decrease the swelling and aids the immobilization. In the first twenty-four to thirty-six hours cold applications help to relieve the pain and perhaps lessen the exudation.

When there is distinct fluctuation in the bursa, aspiration relieves the tension and shortens the course. The aspiration may be easily performed under local infiltration anesthesia through an 18 or 20 gauge needle. After removal of the fluid, a pressure pad or bandage is applied over the collapsed bursa. As a rule, what little residual pain is present may be relieved by mild analgesics such as salicylates.

After the acute exudative phase subsides, usually in two or three days, heat may be of value. Hot water bottles, infrared lamp, the radiant baker, or hot wet applications, used for fifteen to thirty minutes three times daily, help to shorten the period of recovery. At times, the fluid may recur following aspiration but in smaller amounts which are usually spontaneously absorbed. Splinting need be continued for only three or four days but a pressure bandage of elastic adhesive (elas-

toplast) has been found useful for longer periods. Care should be taken to protect the area of the bursa against subsequent trauma.

CASE REPORT

Case 1. T. M., aged 21 years, played on a college football team and injured the right elbow. Two days later the olecranon bursa was found to be tense and tender, and was especially painful when the arm was flexed. Under local anesthesia about 20 c.c. of serosanguineous fluid were removed from the bursal sac. A rubber sponge was applied over a gauze dressing and pressure was maintained by the application of an elastoplast bandage applied with the arm flexed at a right angle. The arm was kept in a sling for three days and a special protective pad was applied over the elbow. The boy was allowed to play in subsequent football games. There was no recurrence of the fluid in the bursa and there has been no evidence of a chronic bursitis in this patient during the five years subsequent to his injury.

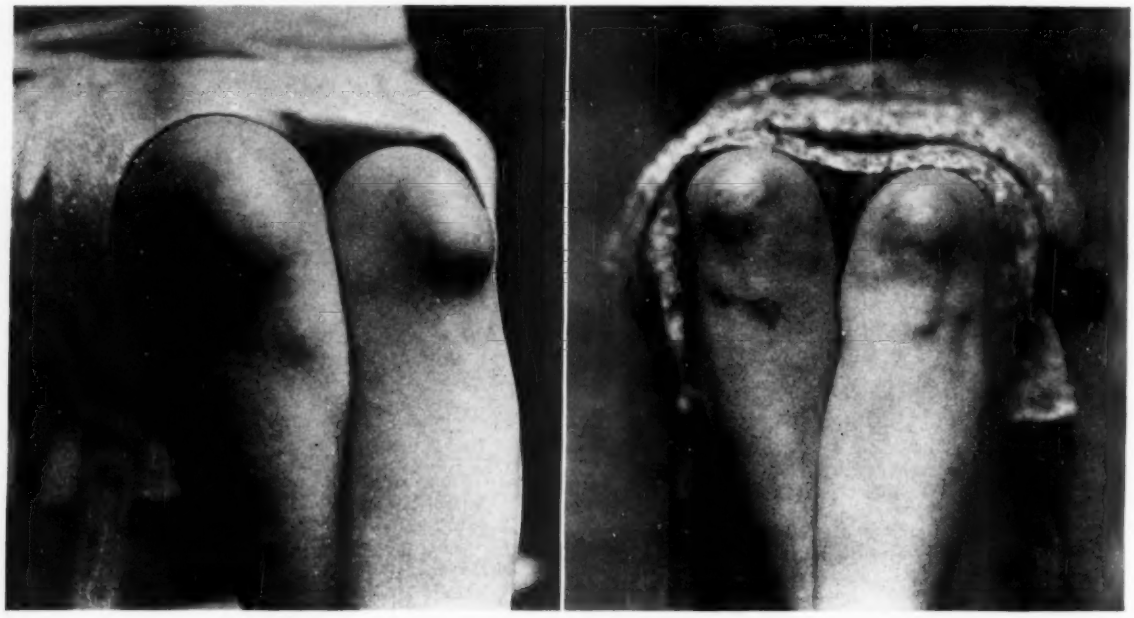
Subacute and Chronic Bursitis. When the trauma is relatively mild, but occurs frequently, or when the resorptive phase of an acute bursitis is repeatedly interrupted by further trauma, fibrous tissue formation becomes the preponderant characteristic. The bursal walls become much thickened; trabecula and villi form and increase in number and density, and fill the space. These trabecula may represent thickening of the septums or folds commonly seen in healthy bursa, or may be stretched-out adhesions between the bursal walls. The villi arise as a granulation in the floor of the bursa, a central blood vessel surrounded by fibrous tissue cells. The granulation tends to grow into the cavity of the bursa, so that eventually there is formed a polyp-like projection consisting of a central vessel and surrounded by a stalk of fibrous tissue. The villi frequently have bulbous tips. Small amounts of fluid are also present. Thus, that which in the very mild subacute form may be clinically evident as a slight palpable thickening of the bursa, may become in the advanced chronic form a large rubbery mass in the subcutaneous tissues containing numerous hard movable bodies.

Frequently, the causal factor in the development of a chronic thickening of the bursa wall is occupational, the patient's work necessitating exposure of the bursa to continued trauma. The occurrence of a chronic bursitis in certain occupations is so common as to have given characteristic names, such as housemaid's knee (chronic prepatellar bursitis), miner's elbow (chronic olecranon bursitis), and so forth. The continued trauma of a shoe to the bursa over a projecting first metatarsophalangeal joint is another instance of similar type.

In a few cases, patients with a chronic bursitis complain of a sharp pain when slight trauma is applied over the bursa. Thus patients describe a feeling of the elbow having been put down on a tack when a hypertrophied villus or trabecula is traumatized by leaning on a hard surface with the elbow. Similar pain is experienced when kneeling in the case of chronic prepatellar bursitis. When these bursa are examined, the bursal sac may be outlined as a thickened, rubbery area containing small, hard, tender and usually movable bodies. These bodies, which are formed by villi springing from the bursal floor, are often so hard as to be confused with bone. When traumatized they become so tender that pressure causes sharp pain. If the bursa can be protected from trauma over a sufficient period of time (three or four weeks), the chronic induration in the bursal wall may subside and the acute traumatic inflammation in the villi disappear so that the bursa is no longer painful. When it is impossible to protect the bursa from repeated trauma, excision is necessary.

By far the largest number of patients with chronic bursitis come for treatment following the application of some recent acute trauma. In such cases there is really an acute bursitis superimposed upon a chronic bursitis. The bursal sac is distended and fluctuant, but on palpation the indurated walls of the bursa are easily noted and the fibrous trabeculation and villi can

be rolled under the fingers. Aspiration of fluid from such a bursa usually results in a rapid and almost complete refilling of the bursa in a period of twenty-four to forty-eight hours, and applications of heat or pressure have little effect, even though applied for several weeks.



A B

FIG. 2. A, chronic bilateral prepatellar bursitis; B, same two months after aspiration and injection of sclerosing solution.

In the treatment of this type of bursitis two methods of approach are available. In one an effort is made to obliterate the sac completely by the injection of some irritating solution into the bursal cavity after aspiration of the contained fluid (Fig. 2). By this method of therapy the sac becomes a firm fibrous scar in the subcutaneous tissue. Various substances have been used for injection. Eising[3] suggests sodium morrhuate 5 per cent solution such as is used for the injection of varicose veins. About 0.75 to 1.0 c.c. may be injected into the space after aspirating the fluid, and a pad, pressure bandage and splint applied. When successful, the bursa is obliterated and with motion a new bursa probably forms. Carp[4] had excellent results with the injection of 2 to 5 c.c. of 3.5 per cent tincture of iodine. In about half of his cases there was reaccumulation of fluid in the bursa; this was aspirated. A cure was obtained in 24 of 27 cases.

Carabba[5] used a solution of the following composition:

Phenol	45 c.c.
Borax	16 gm.
Acid salicyclic	16 gm.
Glycerin	120 c.c.
Spirits of camphor q.s. ad	240 c.c.

After injecting 2 to 3 c.c. of 2 per cent novocain solution into the bursa for anesthesia, he injected 1 to 3 c.c. of the sclerosing solution, and then applied a pressure bandage. The bursa was reinjected at the end of two weeks when necessary.

CASE II. Q. E., housewife, aged thirty-two years, came to the clinic July 18, 1934, complaining of a swelling of the right knee of five weeks duration, and swelling of the left knee of two weeks duration.

Physical examination. Circumscribed prepatellar swelling of both knees was present, each swelling about the size of half an orange. The swellings were not tense or particularly tender (Fig. 2A). A diagnosis of bilateral chronic prepatellar bursitis was made.

Both bursae were aspirated, 10 c.c. of fluid being removed from the right and 20 c.c. from the left. Both bursa were then injected with 0.5 c.c. of phenol, borax, glycerin, spirits of camphor solution.

July 20, 1934 the swelling was slightly reduced in size and slight pain was still present. Eight days later there was almost complete subsidence of the swelling on both sides. September 24, 1934, no swelling or pain was evident in either knee (Fig. 2B).

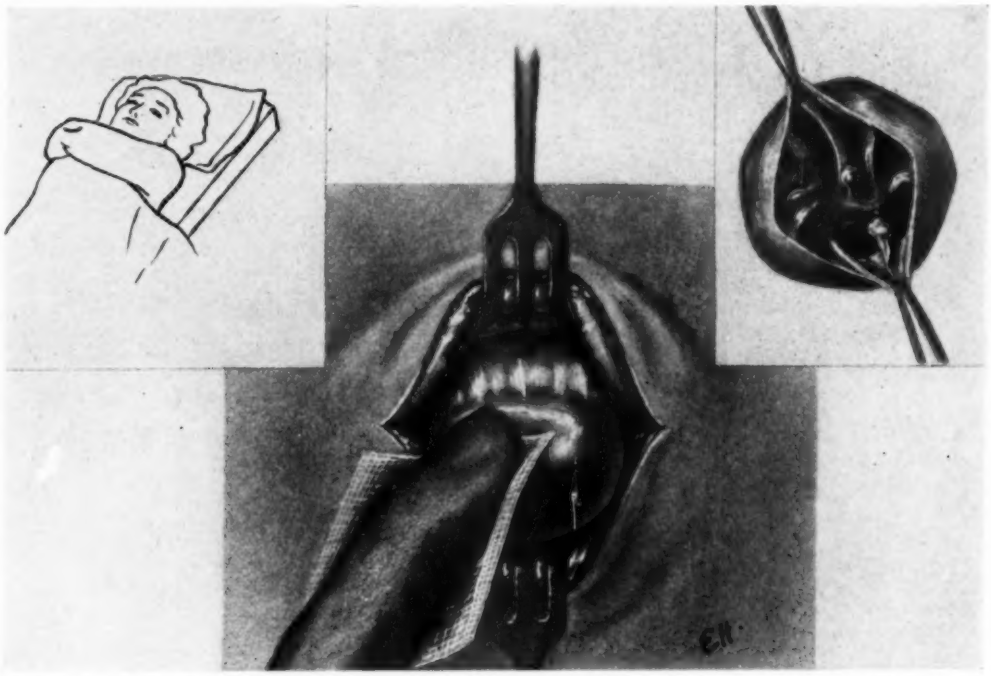


Fig. 3. Chronic olecranon bursitis. Note position of the patient on the table and the site of incision. The opened bursa shows numerous villi and trabecula.

If injection of sclerosing solutions fails to give relief, operation must be considered.

When the prepatellar or olecranon bursa has become very much thickened and protuberant, conservative treatment offers little prospect of relief, and excision should be advised (Fig. 3).

Local anesthesia by infiltration of the tissues surrounding the bursa with 1 per cent procaine hydrochloride is satisfactory if care is taken to inject beneath the bursa so that its dense attachment to the underlying structures is rendered insensitive. The incision should be made away from the projecting point of the joint, and longitudinal. It is sometimes possible to remove the sac in block by combined blunt and sharp dissection. It will be found that the floor of the bursa is attached densely to the underlying tendon and periosteum, and sharp dissection is therefore necessary. Frequently, the periphery of the bursa is thin, breaks through, and the removal is effected piecemeal. The dead space is closed and the wound is sutured loosely. A good result depends on obliteration of dead space in the wound. To this end an elastic pad and firm bandage are applied over the wound, and the part is splinted. Serosanguineous drainage may be somewhat persistent and need not be interpreted as a result of incomplete excision. The application of dressings saturated in 70 per cent alcohol is the most effective method of treating these wounds. It is rarely necessary to remove sutures for drainage of accumulated serum. Healing is usually otherwise uneventful.

Excision of the bursa alone in the bursitis accompanying hallux valgus is of little value. The hallux valgus requires correction in order to secure relief.

Case III. C. W., plumber, aged 42 years, came to the clinic November 20, 1936, complaining of a swelling over the point of the left elbow, which had been gradually increasing for six months. He constantly bumped his elbow at work. There was no pain except for an occasional sticking sensation when the swelling was bumped.

Physical Examination. There was a swelling over the left olecranon process, about the size of a large walnut, sharply circumscribed and giving a sensation of fluctuation through a thick wall. There were several hard nodules palpable within the bursal sac. The diagnosis made was a chronic olecranon bursitis.

Excision of the bursa was performed under local anesthesia, and a pressure pad, an internal right angle splint and a sling were applied. Because of redness of the wound on the third postoperative day, dressings saturated in alcohol were applied. Two days later four sutures were removed and the splint discarded. On the seventh day the remaining four sutures were removed; the wound was clean and the patient was discharged.

Suppurative Bursitis. Suppurative bursitis may follow a laceration or puncture of the skin overlying the bursa, or it may be the result of extension from a contiguous infection. Furuncles over the patella frequently extend to involve the prepatellar bursa.

Seen early, these cases are best treated conservatively. Splinting reduces pain and minimizes tension, rest and hot wet dressings are used and no operation is performed until the inflammatory process becomes well localized. Incision and drainage should be performed under general anesthesia, the bursa and its pockets being laid wide open and packed to maintain good mechanical drainage. Splinting, hot wet dressings and rest are continued until complete subsidence of the infection. Unless there is obvious reason to suspect a complication because of persistent pain or fever, the dressings can be left undisturbed for four to five days; then the packing should be removed and simple dressings applied. Antiseptics are not introduced into the infected wound.

Drainage, particularly when the bursa has previously been thickened and contains numerous trabecula, may continue over a prolonged period, but the wounds usually close without special treatment.

No attempt should be made to excise an acutely inflamed bursa.

Case IV. C. B., aged 30 years, a truck driver, came in July 16, 1934, complaining of fever and pain and swelling over the left elbow. He gave a history of having bumped his left elbow against an iron projection on his truck two days before.

Physical Examination. His temperature was 99.4 and the pulse rate 80. There was swelling of the olecranon bursa with pus oozing from a small perforation over the tip of the olecranon. Cellulitis, extending to the middle of the forearm below and the middle of the arm above, and axillary lymphadenitis were present. Dressings, splint and sling were applied and the patient instructed to keep the arm elevated and soak the elbow in hot magnesium sulphate solution every two hours.

The following day the cellulitis was found to be extending and the axillary adenitis increasing. His temperature was 100.6 and the pulse rate 84. Pus was still exuding from the opening over the olecranon. Under nitrous oxide anesthesia, the bursal space was laid wide open; splinting and soaks were continued.

On July 18 the wound was clean and granulating and the wound edges were approximated with adhesive.

After almost four weeks of persistent serous drainage the wound finally closed and the patient was discharged, with motion at the elbow free and painless.

In September, 1936, follow-up, about two years after his injury, the patient had no symptoms or complaints. The skin was freely movable over the elbow.

SUMMARY

Superficial bursae are spaces developed in subcutaneous connective tissue as the result of frequent movement. When acutely traumatized they respond by forming an effusion and may be treated like any traumatic lesion. Repeated trauma causes induration of the bursal wall with formation of villi and constant effusion. A few

cases may be relieved by conservative treatment or by injection of sclerosing solutions. Excision of the bursa must be performed in the majority of cases. Suppurative bursitis is treated by incision and drainage.

DISEASES OF THE DEEP BURSA

The deep bursa are those which lie between muscle and moving bony projections. Those most commonly found to give symptoms are the following:

1. Subacromial, between the coraco-acromial arch and the deltoid muscle above, and the short rotators of the humerus and the greater tuberosity below;
2. Subgluteal, between the femoral greater trochanter and the gluteus maximus muscle;
3. Iliopsoas, between the capsule of the hip joint and the iliopsoas muscle;
4. Supratrochanteric, in the muscle planes above the greater trochanter;
5. Semimembranosus, between the tendon of the semimembranosus muscle and the inner head of the gastrocnemius;
6. Pretibial, between the quadriceps tendon and the tubercle of the tibia.

Numerous other deep bursa exist in areas where muscles overlie moving bony points but so rarely cause symptoms as to be worth no specific mention.

While the deep bursa are numerous, by far the most frequently involved is the subacromial bursa. Because the lesions produced in this bursa are more or less typical of those involving deep bursa elsewhere in the body, and because of the importance of the symptoms produced, we have chosen to describe the diseases of the subacromial bursa somewhat in detail.

Acute Traumatic Subacromial Bursitis. Whenever a thrust is taken by the hand or forearm, the force is transmitted to the area of the subacromial bursa and the coraco-acromial arch prevents upward dislocation of the head of the humerus, so that every fall on the hand or forearm may cause contusion of the bursal surfaces with slight or even severe bursitis. Injury to the bursa occurs also in all dislocations at the shoulder and in fractures of the upper humerus. This fact is often overlooked in dealing with the more evident bony lesions, but it is probably a factor in the disability produced by these injuries. In young individuals, the bursitis results in little or no final disability; but in the elderly, the bursal lesion, if neglected, may cause persistent trouble.

Acute traumatic bursitis with severe pain may follow a fall in which the point of the shoulder impinges forcibly on a hard object, or it may be secondary to a tear of the supraspinatus tendon or fracture of the greater tuberosity, both of which underlie the floor of the bursa. The patient complains of severe shoulder pain and declines to move the arm, which is held rigidly at the side. Even passive motion causes severe pain. The arm may be passively elevated through 30° to 60° but close inspection reveals this motion to occur by rotation of the scapula on the chest rather than at the scapulohumeral joint. Reflex muscle rigidity in acute bursitis may be so great that abduction is almost impossible, simulating complete tear of the supraspinatus tendon. Palpable swelling and fluctuation may be present, but always there is acute wincing tenderness just below and anterior to the acromion.

The pathological process is essentially identical with that following acute trauma to a superficial bursa, except that adhesions result in pain and limitation of motion.

Following external violence, acute subacromial bursitis is treated, in principle, like any acute traumatic lesion. Immobilization should be in at least partial abduction so as to relieve the tension of the shoulder muscles, and so that any adhesions which form will be separated or stretched when the arm is later lowered. A thick axillary pad, with sling and swath, or an abduction splint, may be used for ambulatory treatment, or the patient may be put to bed with the forearm slung to

the head of the bed to maintain abduction. In the first twenty-four or thirty-six hours, ice bags will help to relieve the pain and perhaps limit the swelling. Much relief of pain follows the use of even a mild analgesic, such as a capsule containing acetylsalicyclic acid grains 7 and phenobarbital grain ⅓. After forty-eight to seventy-two hours, heat (hot water bottle, infra-red lamp or radiant baker) and gentle stroking massage help to shorten the course of the process. In order to prevent adhesions and limitation of motion, gentle passive abduction should be begun as soon as the most acute phase subsides, which is usually in three or four days, preferably by having the patient stoop with the arm swinging at the side. Unless there has been some tearing of the short rotator tendons, recovery will take place in about two weeks.

Case v. C. M., aged fifty years, housewife, came in December 10, 1936, complaining of severe pain in the left shoulder. Two days before she attempted to strike a small boy, swinging her arm downward. She missed her object. There was immediate slight pain in the shoulder which became extremely severe four hours later. She did not sleep for two nights. The pain was constant and sharp, radiating from the shoulder down to the insertion of the deltoid, and became agonizing on attempting movement.

Physical Examination. There was slight swelling in the region of the shoulder with exquisite tenderness over the greater tuberosity in an area about 1 cm. in diameter. The patient resisted any attempt at motion. Voluntary abduction came to about 10 degrees at the scapulohumeral joint. Total abduction was about 45 degrees. *X*-ray examination of the shoulder revealed no evidence of fracture. A diagnosis of acute traumatic subacromial bursitis was made.

A sedative was prescribed and the arm put in an abduction splint. External heat was advised.

The patient had much less pain and her range of motion increased within two days. In another two weeks she had full range of motion and no pain.

Acute Subacromial Bursitis Due to Calcification. One other form of acute subacromial bursitis is common. Following an insignificant trauma, or without obvious cause, the patient begins to have pain in the shoulder. The pain grows worse rapidly and in a few days may be agonizing. The limitation of motion, muscular rigidity, tenderness and at times swelling clearly indicate acute bursitis. The cause of the pain is tension in an area of calcification in the short rotator tendons, usually the supraspinatus. Any movement of the arm, especially in abduction, tends to produce an increase of tension and therefore an increase of pain. Characteristically in these acute cases the calcified mass is relatively large and it appears in the *x*-ray film to be well over the greater tuberosity rather than in the tendon immediately above the humerus. Frequently, the humerus must be rotated into two or more different positions to demonstrate the mass (Fig. 4).

The agonizing pain of acute bursitis with calcification demands immediate relief. Experience has shown that prompt relief may be obtained by relieving the tension in the calcified area. This may be accomplished in two ways.

1. The first method is that of exposing the bursa under local anesthesia through an incision over the greater tuberosity, according to Codman.[6] After separation of the fibers of the deltoid muscle, the roof of the bursa is opened and the area of calcification appears as a white mound surrounded by a ring of injected vessels. Incision of this area permits the escape of a mass of toothpastelike material into the bursa. With this relief of tension there is an almost immediate subsidence of pain. The calcified material which escapes is removed, but no effort is made to completely evacuate the area of calcification. The wound is closed with interrupted sutures. The arm is immobilized with an axillary pad and sling. If appropriate sedative drugs are supplied for the first twenty-four hours, the patient experiences

little difficulty and the whole procedure may be carried out without hospitalization. In about a week, most of the cases have regained full range of motion without pain.

A B

Fig. 4. A and B, calcification in the floor of the subacromial bursa. Note how little of the calcified deposit is visible in A as compared with B, a view taken after rotating the arm.

Case VI. M. C., aged 33 years, bricklayer, came in May 24, 1934, complaining of severe pain in the right shoulder. He first noticed a dull ache in the right shoulder two weeks before, which, within a few days, became so severe that he was unable to work and could sleep only very poorly. He had used various liniments, salves, hot soaks and "sleeping tablets" without relief.

Physical Examination. Well localized tenderness was present over the area of the subacromial bursa. There was pain on abduction, internal and external rotation of the arm.

X-ray examination revealed a marked degree of calcification in the right subdeltoid bursa.

Under local anesthesia, an incision over the shoulder was made at the point of maximum tenderness. The fibers of the deltoid muscle were separated; the bursa was exposed and incised. On incising the calcified area in the floor of the bursa, a white semisolid substance welled out. It had the consistency of thin cream cheese and apparently had been under pressure. This substance was removed as far as possible and the wound closed.

The following day there was considerable relief of pain. On the sixth postoperative day there was no pain, the sutures were removed and the patient was discharged. In April, 1935 on follow-up, the patient had no disability in the shoulder and had been perfectly well since operation.

2. A second method of treatment for this condition is by aspiration of the calcified material and irrigation of the area, as suggested by Smith-Peterson. Under local anesthesia a needle, about 14 gauge, is inserted into the area of calcification and 10 to 20 c.c. of a 1 per cent procaine hydrochloride solution is injected. Attempts at aspiration of the calcified material are then made. If nothing can be aspirated a second needle is often inserted above the first so as to reach the calcified area at another angle. It is then frequently possible to irrigate this area with saline solution. The calcified material becomes suspended in the solution and drains out

through the larger needle. In relieving tension in the calcified area by this method, good results are obtained only if the needle actually punctures the calcified deposit.

Considerable discomfort is experienced for twenty-four hours after this treatment and adequate sedatives should therefore be given. After this period the pain and disability rapidly subside so that complete function may usually be resumed in three or four days.

CASE VII. J. S., aged 33 years, a nurse, came to the clinic December 4, 1936, complaining of agonizing pain in the left shoulder of seven days duration. She had been unable to sleep for two nights and could not move her arm without extreme pain. An *x*-ray plate showed an area of calcification over the greater tuberosity (Fig. 4). A diagnosis of an acute subacromial bursitis with calcification was made. Two needles were inserted into the calcified area under local anesthesia and considerable calcified material was removed by aspiration and irrigation. Within a week there was complete relief of pain and a full range of motion.

Subacute and Chronic Subacromial Bursitis. When there is thickening and roughening of the bursal surfaces so that the head of the humerus does not glide smoothly under the acromion, there is produced the clinical picture of a subacute or chronic subacromial bursitis. These changes in the bursa may be simply posttraumatic, following an injury to the bursa and immobilization of the arm at the side. Frequently, the cause may be slight calcification of the short rotator tendons, with roughening of the floor of the bursa; less commonly, the irritant may be hypertrophy of the greater tuberosity resulting in friction when the tuberosity slips beneath the acromion in the process of elevation of the arm.

Clinically, whatever the cause, the condition presents much the same picture. Pain in the shoulder comes on, increases slowly, and is commonly worse at night. In some patients the chief complaint is of pain at some point in the abduction arc; in others the ability to elevate the arm becomes less. There is limitation of scapulohumeral motion, and, in advanced cases, abduction takes place mainly by rotation of the scapula on the chest. Limitation of internal and external rotation are frequent. Crepitation is often palpable with shoulder motion. When the condition has persisted for any length of time, atrophy of the deltoid and supraspinatus muscles may be seen. Tenderness over the greater tuberosity is present. A history of trauma in these cases is unreliable, and *x*-ray examination may show calcification or changes in the greater tuberosity.

The first objective in these cases is to restore motion and thereby to relieve pain. The pain may be obstinately persistent, but will clear up if good motion is restored and maintained by exercises.

Open operation, except when the greater tuberosity shows marked hypertrophy, has given disappointing results. Under local anesthesia, such as infiltration of the bursa with 20 to 30 cc. of 1 per cent procaine hydrochloride, or under general anesthesia, manipulation with gentle but firm motion of the shoulder through its full range gives immediately greater function and, in a few days, less pain. Stooping exercises of the shoulder to the limit of pain must be carried out three or four times daily.

The application of heat, three times daily, followed by a mild counterirritant, such as chloroform liniment or methyl salicylate, in gently massaging the shoulder, gives a considerable measure of comfort. The analgesic capsule mentioned above also helps.

The patient should be apprised of the stubborn character of the lesion, with nevertheless an excellent prognosis.

CASE VIII. N. T., aged 52 years, laborer, came to the clinic November 12, 1934, complaining of pain in the right shoulder. This began eight months before when he fell on his

extended arm. The pain was dull in character and gradually became worse.

X-ray examination showed "in the proximal end of the diaphysis of the humerus an area of diminished density circumscribed by a zone of increased density, the identity of which is uncertain. It may represent an inflammatory process."

Physical Examination. There was weakness of the muscles of the right shoulder. He was unable to lift the arm beyond 90 degree abduction. Palpable crepitation was present over the area of the subacromial bursa on rotation or abduction of the arm. A diagnosis of chronic subacromial bursitis was made. Under local anesthesia an incision 3 inches long was made over the anterior aspect of the head of the humerus and the fibers of the deltoid muscle were separated down to the bursa. The bursal wall was then incised and many hypertrophied villi were exposed and removed. Two sharp projections from the lesser tuberosity were trimmed off. The deltoid muscle was sutured with catgut and the wound closed with silk. Immediately after operation the patient could easily bring the arm into full abduction.

Three days later motion was improved, pain was very slight and only occasional. Exercises were started two days previously. The sutures were removed on the fifth day and the wound was clean. On the sixteenth postoperative day there was almost complete range of motion without pain and the patient was discharged.

Case IX. H. S., aged 65 years, a grocer, came in November 7, 1936, complaining of pain in the right shoulder which began six weeks before, when he fell, striking the shoulder.

Physical Examination. There was marked limitation of abduction, moderate limitation of internal and external rotation and tenderness over the anterior surface of the head of the humerus. A diagnosis of chronic subacromial bursitis, post-traumatic, was made. *X*-ray examination showed a suggestion of some decalcification of the greater tuberosity.

After injection of 30 c.c. procaine hydrochloride 1 per cent solution into the bursa, the arm was manipulated to obtain full range of motion at the shoulder. Stooping exercises were prescribed. An acute exacerbation occurred after the manipulation, but subsided. Five days later almost full range of motion was present and the pain was considerably less. External heat and exercises were prescribed. November 20, the patient had full range of motion but still had pain. December 26, 1936, the patient still had slight pain, but much less than before, and there was a full range of motion.

Inflammatory lesions of the other deep bursa are uncommon. The bursa above the greater trochanter of the femur occasionally undergo calcification and give symptoms simulating hip-joint disease.[7]

The pretibial bursa, located beneath the lower end of the patella and behind the attachment of the quadriceps tendon, also occasionally gives symptoms.

Excision of these bursa appears to be the most satisfactory treatment.

SUMMARY

Bursa are potential spaces which develop in connective tissue in response to movement or friction. Superficial bursa develop in the subcutaneous fatty tissue between the skin and bony points; the diseases peculiar to this type have been discussed and their treatment outlined. The deep bursa lie between moving bony points and overlying muscles. Of these the subacromial bursa gives symptoms most frequently, and a discussion of its diseases has been given as typical of those of all deep bursa.

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GENOSCOPOLAMINE IN OBSTETRICS

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GENOSCOPOLAMINE medication has for its objective a safe "twilight sleep" that is not a complete analgesia and not a complete amnesia, but a definite and adequate quantity of both with resulting amelioration of the terrors of labor. If the parturient's pains are lessened in degree so they are quite bearable, if she remembers her confinement only in a vague sort of way, and if she sleeps between her pains yet is always able to cooperate with the physician and nurse, the objectives of this medication have been achieved.

These objectives may be reached by the use of genoscopolamine adjusted with a small initial dose of morphine, without increasing the incidence of attending complications in the various stages of labor, and without imparting medicinal toxicity to the passenger.

This medication is thus not a panacea for expectant mothers, but does provide the parturient, in a way safe to both mother and child, with a high degree of amnesia and analgesia during the trials of labor without handicapping the attending physician by loss of his contact with, and control over, the patient.

Clinical observations were made on the obstetrical wards of Knickerbocker Hospital, New York City, on the service of G. L. Brodhead, M.D. Varied doses of genoscopolamine and morphine were given to twenty patients to determine the most advantageous manner of using the drug. The following technique was found to be the most efficacious, and observations were made on forty-two additional patients under this method of administration. After labor is definitely established as judged by the obliteration of the cervical canal and definite regular, but not necessarily severe, uterine contractions, the first dose is given by intramuscular injection consisting of Genoscopolamine gr. 1/120 (.003 gm.) and morphine sulphate gr. 1/6. If the patient is not sleeping or at least dozing between pains after forty-five minutes, two-thirds of another ampule (.002 gm.) may be given by intramuscular injection.

Morphine is not indicated or needed after the initial dose. Additional doses of genoscopolamine are frequently unnecessary, although after four or six hours another ampule (.003 gm.) may be given if the patient no longer sleeps quietly between her pains. Occasionally three doses of Genoscopolamine are indicated and two doses may be given within two hours if necessary without untoward results. The usual manifestations of Scopolamine medication such as dryness of the mouth and flushing of the face are frequently manifested on the parturient, but are not contraindications for subsequent doses as outlined, although vomiting may intervene if the patient's thirst is quenched.

During the first stage of labor several reactions on the part of the patient may be encountered. It is obviously difficult to classify parturients, due to the varied responses they show to their labor pains, and accordingly any medication given will produce results depending for a large part upon the individual mental composition of the subject.

The usual response to this medication, as outlined, is a quiet restful patient, sleeping peacefully between her pains. She apparently wakes with the pain and stirs slightly in bed, but before she becomes fully aroused the pain has disappeared and she lapses back into quiet slumber. She may complain, when aroused and asked, that

her tongue is dry, that she is slightly dizzy, or has a hazy mind. She is completely capable and willing to cooperate with the physician and nurse. In retrospect after delivery, she has little or no conception of having had pains. If she does remember her labor her memory is very slight and far from complete or detailed.

A few patients do not respond as satisfactorily as described. Some of these do not get sufficient amnesia and analgesia due to inadequate dosage, and will respond satisfactorily with subsequent doses as above outlined. Occasionally an excitable individual is met who becomes anxious about the subjective symptoms of thirst and dulling of her sensations, but responds satisfactorily to further medication. Other women, being hypersensitive to pain, will complain that all of their pains were not entirely relieved.

The only undesirable reaction noted to this medication is met with in those rare patients who have a tendency towards hysteria and enter their confinement with the definite anticipation of releasing their inhibitions. This type of patient would be hysterical with no medication, yet would not cooperate with any form of medication not providing complete analgesia. Observation of this type of patient reveals that they are naturally difficult to deal with when not receiving medication and are incapable of logical reasoning. Of three such cases noted, one will be discussed later, while the other two cases noted refused courteous and capable post-partum care and signed out of the hospital against advice shortly after delivery. These patients may be recognized and other medication given with even more unsatisfactory results. If the medication is given to a patient of this type, she is extremely uncooperative and restless with her pains, though relaxing between them. She needs someone with her constantly, and during delivery a general anesthetic is the most satisfactory method of controlling her delirium. This type of patient has a complete amnesia, remembering not one detail of any nature concerning any part of her confinement after receiving medication. Genoscopolamine given to a prospective mother who is not of the flighty, irresponsible, hysterical type mentioned, exhibits none of this reaction.

No maternal toxic symptoms other than those mentioned early in this discussion have been noted. However, one patient with a personal and family history of mental aberrations, who received the initial dose of genoscopolamine and morphine five hours before delivery, was maniacal during all stages of labor and suffered a complete inversion of the uterus following a normal spontaneous delivery. The uterus was replaced and packed immediately but hemorrhage continued until death occurred five hours after delivery. This is the only incident in this series of cases where the question of drug sensitivity could be raised in regard to morphine or genoscopolamine.

Relatives viewing this patient during her deliriums stated that they had seen her in the same physical state following a tooth extraction seven years prior and were therefore not perturbed by her actions. Mental and emotional abnormalities that had insidiously developed in the two years preceding this delivery were cited by the husband, who also stated that the patient's mother was not mentally sound. No comparable details of this patient's other delivery three years before could be obtained. In this case apparently the mental background was responsible for the lack of cooperation and deliriums, and the spontaneous inversion of the uterus with subsequent hemorrhage was responsible for the fatal termination.

Fetal toxicity has not been noted. Usually the passenger breathes as soon as its head is over the perineum and cries lustily as soon as it is laid down. This has been the universal response of the spontaneously delivered infant regardless of the amount and time of medication. Occasionally the time of delivery has been misjudged and the initial dose given

thirty minutes before spontaneous delivery, with no degree of asphyxia of the infant and satisfactory amnesia and analgesia of the mother. Occasionally, when forceps had been used, the infant received some external stimulation before respirations were satisfactorily established. One patient treated before technique of medication was standardized, was given genoscopolamine gr. $\frac{1}{20}$ (.003 gm.) and morphine gr. $\frac{1}{6}$ for both first and second doses, one hour apart, and delivery occurred one hour after last dose was given. Thus in the two hours preceding delivery she received morphine gr. $\frac{1}{3}$ and genoscopolamine gr. $\frac{1}{10}$ (.006 gm.). The patient was completely cooperable but the maternal respirations were depressed and further anesthesia not given at time of delivery. Median episiotomy was performed and repaired, delivery being uneventful. The infant cried lustily before it was completely delivered. Amnesia and anesthesia were complete except for one momentary painful sensation at the time episiotomy was made.

During the second and third stages the cooperation of the patient is somewhat related to the degree of amnesia and analgesia obtained. If amnesia is complete, she usually does not cooperate well. If the desired analgesia has been obtained, she does cooperate well. If episiotomy, forceps or manipulation is necessary, about one-half or at most three-quarters of the usual amount of general anesthesia is sufficient to obtain the necessary anesthesia and relaxation. Following delivery, the patient is enabled to sleep comfortably for several hours without additional medication.

In one case the initial dose was given before labor was definitely established, resulting in a restful sleep of eight or ten hours duration. Labor started fifteen hours after medication and was completed normally. In all other cases it was never noted that contractions became less efficient or less frequent, but the contrary was invariably seen; that is, the contractions were more effective and more frequent. It was felt that labor was frequently shortened and that it was never prolonged.

With the usual technique of 1 c.c. of obstetrical pituitrin at the end of the second stage, and an ergot preparation at the end of the third stage, no increased tendency to bleeding was noted. However, one patient receiving this routine medication suffered a first degree hemorrhage when the uterus failed to contract promptly following the third stage of labor. Packing with iodoform gauze was immediately performed with the aid of the Brodhead packer. The only other excessive bleeding encountered was previously mentioned in association with complete spontaneous inversion of the uterus.

Several surgical patients were given genoscopolamine gr. $\frac{1}{20}$ (.003 gm.) and morphine sulphate gr. $\frac{1}{6}$ as routine pre-operative medication one hour before operation. Even nervous, apprehensive patients arrived in the anesthesia room on the verge of slumber, if not sleeping, and all exhibited a remarkable calmness devoid of any anxiety or worry. Surgeons reported good relaxation of the patient under general anesthesia, and anesthetists reported a quiet induction and the total anesthetic necessary as approximately one-third less than the expected amount. Post-operatively, the patients slept quietly for several hours with surprisingly little reaction to the anesthesia. Many did not remember even going to the operating room, others just remembered leaving their bed in the ward. Dr. G. H. Van Gilluwe of New York City is conducting further detailed studies at the Metropolitan Hospital on the use of genoscopolamine as a pre-operative medication.

Genoscopolamine was first described by Max and Michel Polonovski in 1925. By its chemical function it belongs with the aminoxide group of alkaloids. It is prepared by detailed treatment of scopolamine and H_2O_2. The bromhydrate of oxide of scopolamine having the formula $C_{17}H_{21}O_5N$, HBr, is the intermediary product from which genoscopolamine is

derived as a crystaline powder that is eminently soluble in water. It is soluble in alcohol, neutral to litmus and by reduction regenerates scopolamine. The genoscopolamine formula evidently results from blocking the tertiary nitrogen of scopolamine by aminoxide oxygen.

Genoscopolamine possesses qualities identical with the alkaloid from which it is derived, but these potentialities are so chemically bound that the active principal is slowly released. Thus, large therapeutic doses of the genalkaloid may be given with the desirable therapeutic effects of the original alkaloid, but not a comparable toxic reaction.

In animal experiments conducted by these investigators it was found that the toxic dose of genoscopolamine was 200 times greater than that of scopolamine. As much as 1.25 gr. of genoscopolamine was injected into a 6 Kg. dog without fatality. With 0.10 gm. per Kg. given intravenously, torpor and deep anesthesia were obtained. Larger doses, however, produced violent cerebral excitation, the dogs presenting the appearance of madness, but the phenomena disappeared rapidly. Chronic intoxication was produced with massive doses for nine days and the kidneys examined for evidence of pathological changes. Though the microscope showed several burst cells in Henle's loop, it did not appear that genoscopolamine had any toxic effect on normal kidneys.

CONCLUSION

1. Genoscopolamine used according to the described technique gives satisfactory analgesia and amnesia during the trials of labor.

2. Its administration is accompanied by no maternal toxic symptoms other than flushing of the face and dryness of the mouth, although some nervous women with hysterical tendencies obtain complete amnesia with cerebral irritation to the usual dose.

3. It does not increase the incidence of operative intervention nor delay the normal process of labor.

4. No fetal toxicity was noted, the inauguration of fetal respirations being accelerated, if any thing, rather than retarded.

5. Its use as a pre-operative medication on patients not having labor pains indicates that it markedly diminishes pre-operative anxiety and apprehension, greatly reduces the amount of general anesthetic necessary for relaxation, and continues to act as a post-operative sedative.

6. Genoscopolamine deserves more extensive clinical trial both as an obstetrical analgesic and amnesic, and as a pre-operative medication.

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THE CHANGES IN INFRA-RED PHOTOGRAPHS TAKEN DURING THE TREATMENT OF VARICOSE VEINS*

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THE infra-red photograph will visualize superficial veins, visible and concealed varicosities, and venous dilatations due to obstruction.[1,2] This fact has suggested that the infra-red photograph might afford a satisfactory index of the progress of treatment of varicose veins by showing changes in the appearance of the vessels corresponding with the obliteration of the varicosities. This possibility, though not substantiated by photographs, has been indirectly suggested by Payne[3] when he proposes that the method may have application "in connection with the prognosis after injection of varicose veins and in the investigation of venous collateral circulation."

To determine whether clinical progress is accompanied by changes in the infra-red picture, a number of cases have been photographed at intervals by infra-red and conventional technique. Two of these cases are presented to illustrate the possibilities of this method of clinical control.

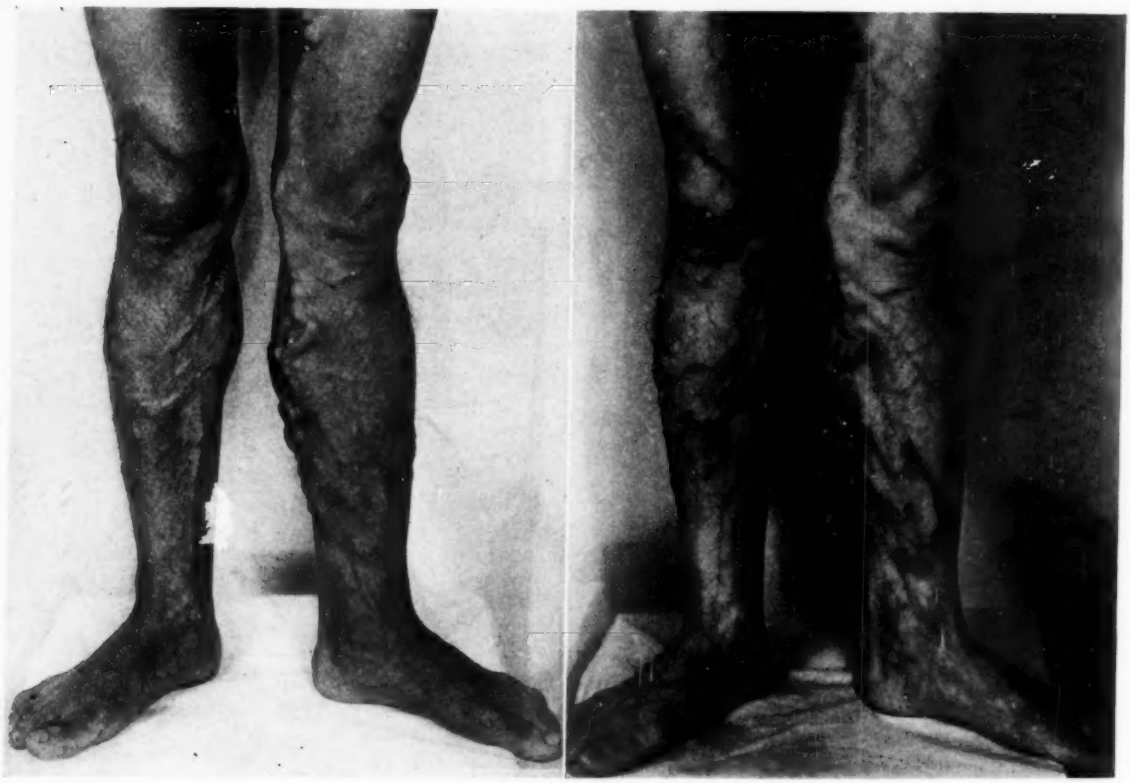

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FIG. 1. A, conventional photograph F. H. Before treatment began. September 24, 1935. B, infra-red F. H.

CASE 1. F. H., a Japanese male, aged 55, a chef by occupation. There were large varicosities of both legs, most marked on the left side and the left great saphenous vein was easily palpable to the groin. Ligations at the saphenofemoral junction were done before injections

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were given. Figure 1 shows the condition before any treatment had been given. The left leg was treated first and a satisfactory clinical result

Case II. W. T., a white male, 65 years old, and a butcher by occupation. There were no marked grossly visible tortuosities on either leg.

A B

Fig. 2 F. H. A, conventional photograph. Condition before ligation and treatment of right leg. Left leg has been treated. November 26, 1935. B, F. H. Infra-red photograph.

obtained before any work was done on the right leg. At this stage of progress, Figure 2 was taken. Figure 3 illustrates the condition two months after discharge and when an excellent clinical result had been obtained on both legs.

The results obtained by the infra-red photograph are dramatic in that they parallel the marked clinical improvement noted in this case. Two months after discharge, the veins which had been injected were very much reduced in size, were firm, hard, and cord-like on palpation. Though the clinical improvement has been so satisfactory, minute tortuous veins which appear only on the infra-red photograph remain unaffected by the injections given to the large palpable venous trunks. On palpation there were enlarged rubbery superficial varicosities which dilated into thin walled sacculations along their course. A pigmented area was present on the postero-medial surface of the right leg. Figure 4 shows the condition of the extremities before treatment and Figure 5 illustrates the result after treatment. After treatment, an excellent aseptic thrombosis of the superficial veins had been obtained and the original rubbery characteristics of the patent veins were replaced by a cord-like hardness.

In Case II, the rubbery varicosities with their thin walled sacculations were more marked by palpation than by inspection (Fig. 4). Even the infra-red photo does not give adequate information as to the actual size of these veins (b_1). Paradoxically, a

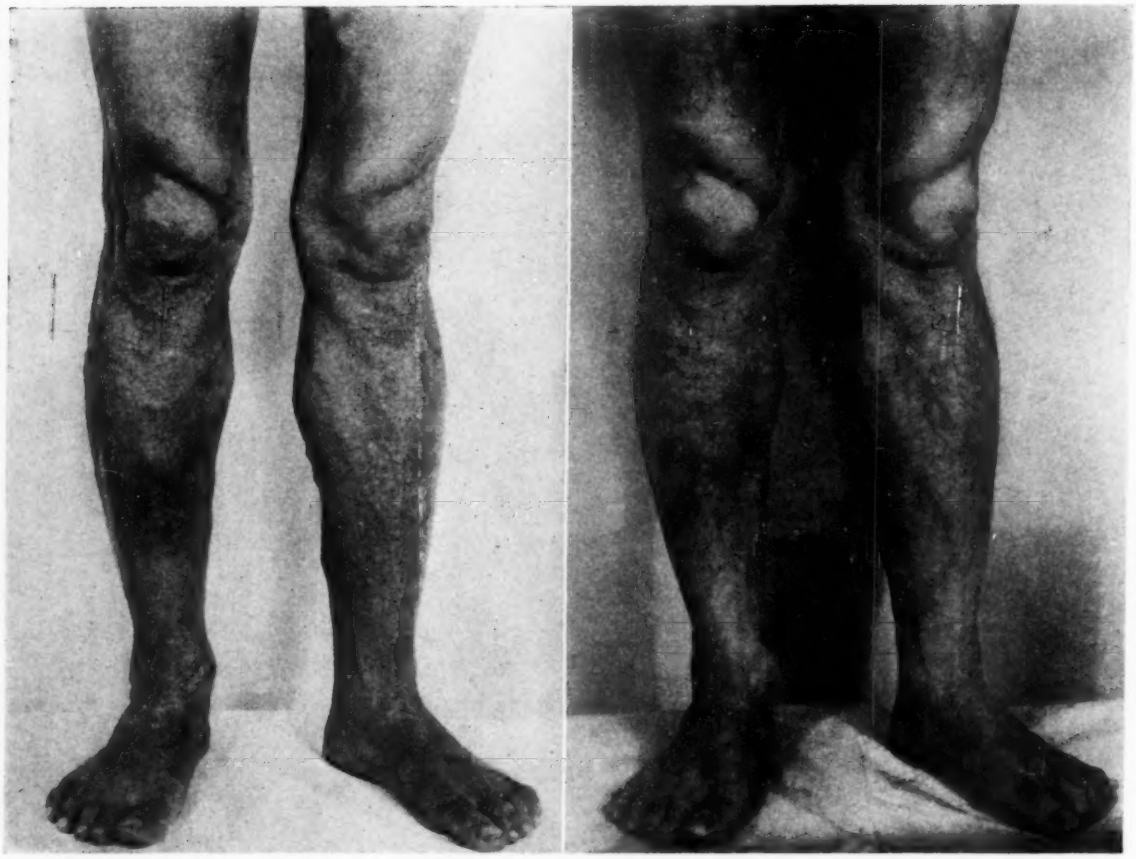

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FIG. 3. A, conventional photograph. Condition two months after discharge. September 24, 1936. B, infra-red photograph.

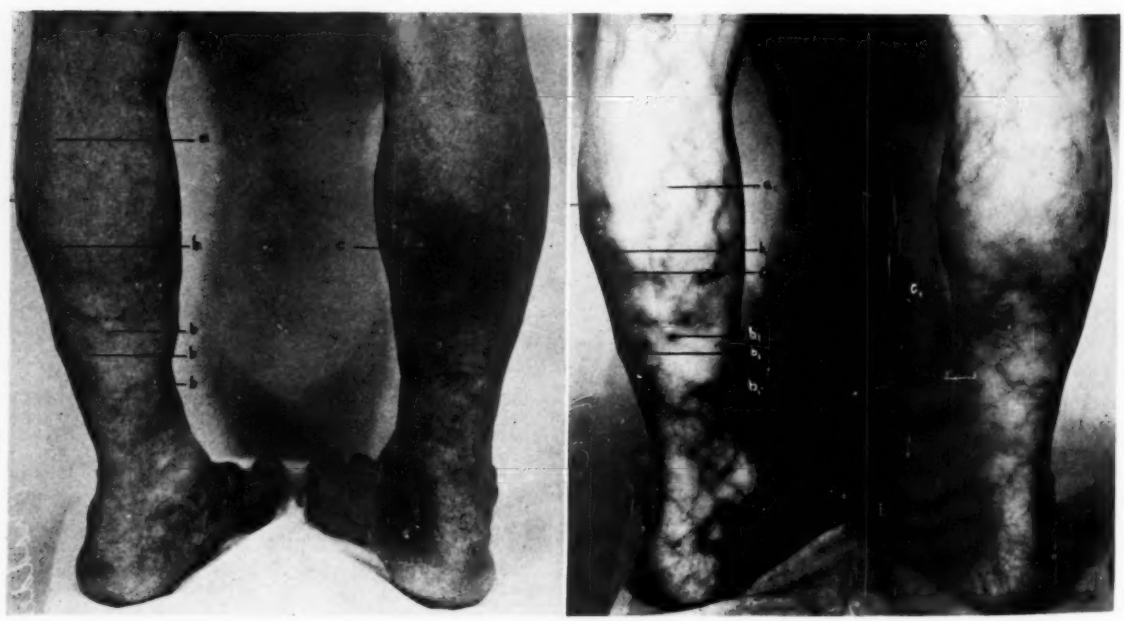

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FIG. 4. A, conventional photograph. W. T. Before treatment began. February 25, 1936. B, infra-red photograph.

small vein (a_1) appears on the infra-red photograph with almost startling sharpness and tortuosity but is neither palpable nor evident by direct inspection. After treatment, the rubbery elastic veins were replaced by firm hard cords. These results are not apparent on the conventional photograph nor is there any appreciable change in the infra-red picture (Fig. 5). The shadows in Figure 4 marking the positions of the sacculations (b_1) and the larger superficial trunks (d_1) are only slightly less distinct in Figure 5 ($2b_1$, $2d_1$). The most marked improvement is noted in the pigmented area on the right leg in Figure 4 which has become much smaller in Figure 5. The injections of the larger veins has had no effect on the small sharply outlined varicosities on the infra-red picture and which were impossible to demonstrate or inject in the clinic because of their size.

Since small varicosities persist in the infra-red photographs after the maximum clinical result has been obtained by injection of the large trunks, the problem arises as to what constitutes the greatest therapeutic effect using the infra-red picture as a yard-stick. Zimmerman and Rattner[2] and Haxthausen[4] have taken infra-red pictures of normal and varicose veins for comparison. Normally, the superficial veins are rather slender, running a fairly straight course without any marked dilatation or other changes in caliber. Thus the venous network appears as a number of triangles, quadrangles, and polygonal figures. The varicose vein differs from the normal in a thickening of the vessels, a winding and twisted course, and irregular, localised pouchings of the vessel walls. The visibility of subcutaneous veins by infra-red photography, however, is dependent upon the thickness of the skin, the vein wall, and the size of the vein. Payne has found that this method of demonstrating varicosities is more successful in women than in men because of the thinner skin.

A B

Fig. 5. A, W. T. Conventional photograph. Condition on discharge. April 28, 1936. B, W. T. Infra-red photograph.

In the infra-red photographs presented, the clarity of the small tortuous veins on the infra-red picture as compared to the relatively indefinite outlines of the large trunks, may be explained by the more superficial position of the former and the thinness of the overlying tissues. The greater thickness of the walls of the large veins is also a factor in reducing their visibility by infra-red photography.

The same factors which determine the infra-red visibility of subcutaneous veins are elements which must also be considered in the evaluation of the infra-red photograph as an index of therapeutic progress.

CONCLUSIONS

1. Changes in serial infra-red photographs do not necessarily parallel the findings obtained by clinical examination of varicose veins under treatment.

2. The infra-red photograph may fail to demonstrate satisfactorily large veins of immediate clinical significance. Consequently, it may fail to demonstrate the obliteration of these veins after treatment.

3. The persistence, after otherwise successful treatment, of small tortuous veins in the infra-red picture and which are not demonstrable clinically, may be a determining factor in the prognosis and permanency of "cure."

4. The thickness of the skin overlying the vein, the thickness of the vein wall, and the size of the vein are determining factors in the infra-red visibility of superficial veins.

5. The same factors which influence the infra-red visibility of varicosities must be considered in the evaluation of the infra-red photograph as an index of therapeutic progress.

6. The value of the infra-red photograph of varicose veins might be enhanced by the use of stereoscopic infra-red pictures. This would give a "third dimension" and might give valuable information concerning the venous circulation at different levels in the skin.

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Miss Madge Walsh, of the photographic department of the Northwestern University Medical School, assisted in preparing the photographs.

INFRA-RED PHOTOGRAPHY IN THE DIAGNOSIS OF VASCULAR TUMORS*

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INFRA-RED photography is a well known, valuable diagnostic procedure frequently used to demonstrate the pattern of hidden varicose veins.

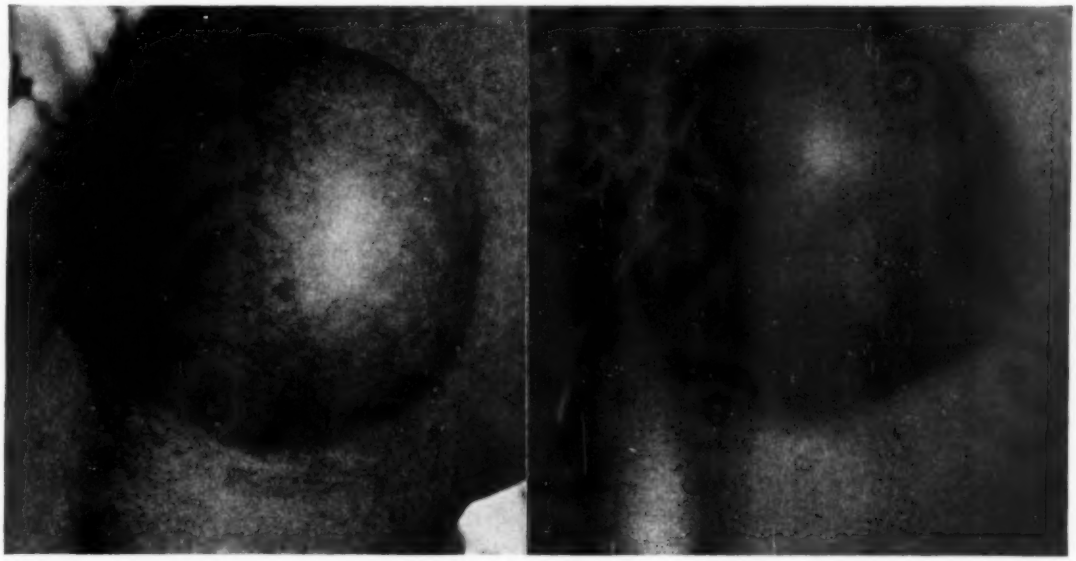

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FIG. 1. (A) Ordinary. (B) Infra-red photograph. A 2 months old baby girl born with a tumor on her back which has not changed since. It does transilluminate. No bulging of fontanel on pressure. It could be a cyst, a meningocele, a lipoma. Transillumination and infra-red photography demonstrate absence of blood.

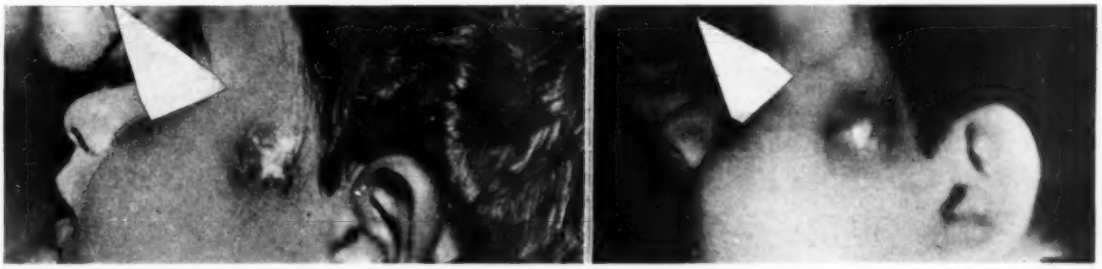

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FIG. 2. (A) Ordinary. (B) Infra-red photograph. A 6 year old boy with remnants of a hemangioma treated with radium. Transillumination, palpation, provoked local congestion, showed only scar tissue. The shadow obtained with infra-red photography demonstrates small blood cavities still present about the area.

It is useful mostly in varicosities of the veins of the lower extremities. I used it in a few cases of invisible veins at the bend of the elbow. Everybody knows how annoying for patient and operator it is to locate difficult veins in a busy antisyphilitic clinic. Although in only a small per cent of the cases this method helped in directing the needle, I think it deserves further experimentation.

* Department of Dermatology of the Rhode Island Hospital, Providence, R. I.

Infra-red photography is most gratifying in cases of intracutaneous or subcutaneous vascular tumors, covered with normal skin, in which the presence or absence of blood could not be positively demonstrated by inspection, palpation, provoked local congestion or even transillumination.

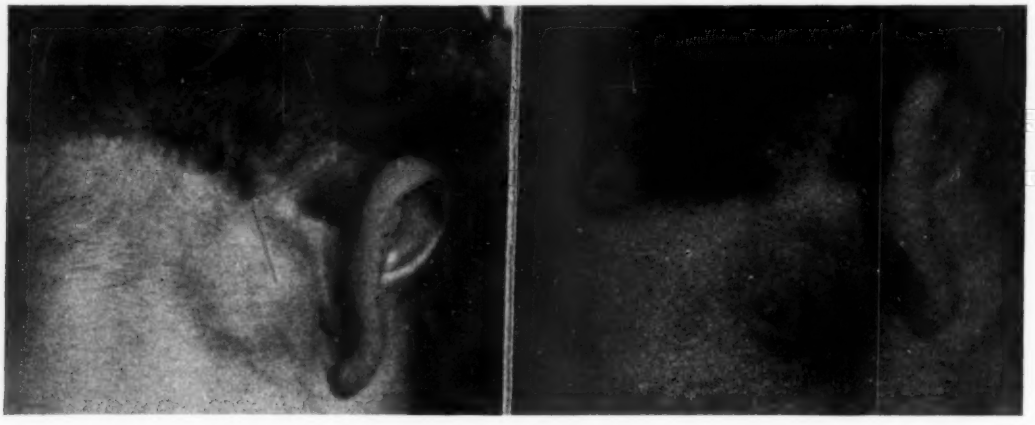
There are cases in which the diagnoses: hemangioma, hemolymphangioma, lymphangioma, cyst, lipoma, meningocele, teratoma, have equal chance to be right or wrong.

A peculiar shadow, not visible with an ordinary clinical photograph, will indicate blood spaces and will point toward the diagnosis of hemangioma.

Infra-red photographs are obtained with an ordinary clinical camera, special infra-red plates, a special filter, and an incandescent tungsten filament lamp (500 W.), with an exposure time from three to five seconds.

Further details of technique and references can be obtained from the papers of Haxthausen, Massopust and others.

Most of the cases of doubtful hemangiomas are in infants, and the requirement of a certain length of exposure, which prevents the use of a photoflash bulb, is a serious handicap. As a matter of fact, while a hemangioma in a crying, restless baby shows better with an ordinary photograph, using a photoflash bulb, it is



A B

FIG. 3. (A) Ordinary. (B) Infra-red photograph. A 2 year old boy with a small tumor in back of his right ear, covered by an absolutely normal skin. No bluish discoloration, no veins around. Infra-red photography shows a marked shadow and a few applications of radium make the tumor disappear, so confirming the diagnosis of hemangioma.

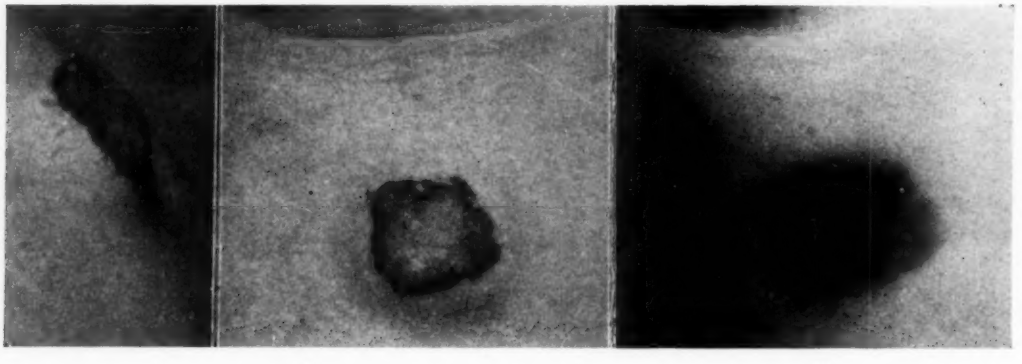


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FIG. 4. (A) Ordinary. (B) Infra-red photograph. A 7 months old girl with a tumor on the middle of her back, the size of a pigeon's egg; in part a definite but superficial hemangioma (strawberry type), in part a deep seated cavernous hemangioma, covered with normal skin not surrounded by venous net, without bluish discoloration with local congestion. Infra-red plates, in spite of the restlessness of the patient, demonstrate clearly the blood collection under a normal skin. Radium therapy melted away the cavernous hemangioma, and did not modify, as usual, the superficial one.

impossible to obtain a good infra-red photograph with an uncoöperative patient, because of the requirement of a time exposure.

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A B

Fig. 5. (A) Ordinary. (B) Infra-red photograph. A 6 months old boy with a small superficial strawberry mark on his nose and a faint bluish discoloration on the tip of his nose. Infra-red photographs show a considerable amount of blood in the skin of the nose. Note a small subcutaneous hemangioma near the right ear.

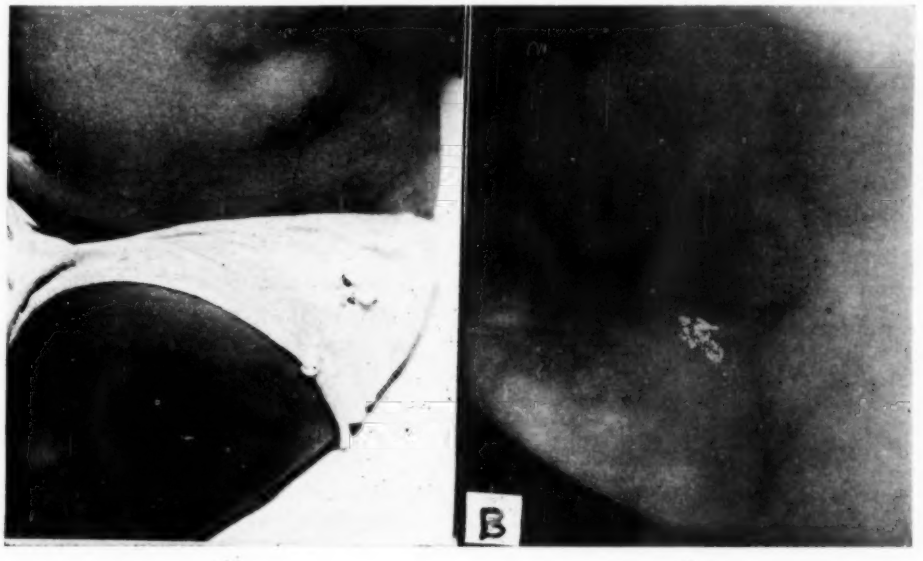

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Fig. 6. (A) Ordinary. (B) Infra-red photograph. An 18 months old boy with an elongated, soft, cutaneous mass, the size of a small hen's egg, on his abdomen. Not the slightest sign of blood with ordinary diagnostic investigations. Infra-red photography demonstrates a deep seated hemangioma and large tributary veins. Radium therapy reduced the tumor as usual.

The illustrations of cases from the Department of Dermatology and the Tumor Clinic are self-explanatory.

SUMMARY

Infra-red photography is a valuable method of investigation in the diagnosis of vascular cutaneous tumors in the living, when the presence of blood is doubtful.

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THYROID DISEASE IN THE SMALLER HOSPITAL*

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THE criterion for judging the merit of any therapeutic measure resides in an intelligent appreciation of the ultimate benefit to the patient. An accurate evaluation of end-results over a long period is always difficult; questionnaires are usually unsatisfactory and personal interviews are frequently impossible. The data presented were culled from records representing an experience of thirty years. No letter was accepted as bona fide evidence of relief, nor were results approved unless surviving patients were examined by a staff physician not less than one year after treatment.

In this series of 205 patients, 203 operations were performed from 1902 to 1932. Seven patients were operated upon more than once, and one, a woman of thirty-three years, had four, three recurrent, non-toxic nodules being removed. A completely satisfactory hospital record was available in 151 instances and 138 patients were examined frequently during periods varying from one to thirty years.

A review of case records shows the following points of interest:

Age. Most of the non-toxic patients were in the second decade of life, after which there was a decline in incidence (Fig. 1). The youngest representative of the diffuse goiter group was eleven years and the eldest sixty-one years of age. In the nodular non-toxic group only one patient was under twenty-one years, a girl of fifteen years who had noticed the nodule two years before admission. There were 42 nodular non-toxic goiter patients between the ages of twenty-one and fifty-six years; 25 of these were in the third to fifth decades, with the least number, 7 present in the fifth. The average age incidence of diffuse non-toxic goiter was twenty-seven years, of nodular non-toxic thirty-eight years, and both types thirty years.

Twenty-eight patients had hyperthyroidism; 17 were of the diffuse and 11 of the nodular type. The average age for those with diffuse toxic goiter was thirty-two years, the youngest nineteen and the eldest 56 years. For those with nodular toxic goiter the average age was forty-two years, the youngest nineteen and the eldest fifty-eight years. Of the former, the greatest number, 9, occurred in the third decade, and of the latter, 5, in the fourth decade. The combined groups averaged their greatest incidence at the age of thirty-seven years. Figure 2 shows a gradual increase in the percentage of toxic cases from the latter part of the second to the end of the third decade. From that period there is a temporary and partial percentage decline to the end of the fourth, from which there is a secondary rise through the fifth and a sharp drop early in the sixth decades. Thirteen and six-tenths per cent of all cases were toxic.

Sex. Of 170 non-toxic patients 25 were males, a ratio of approximately 1/7. Of the 28 toxic cases, 3 were males, a ratio of approximately 1/10. These statistics compare aggreably with the usual experience.

Heredity. In this series family histories are unfortunately inadequate. Five patients gave a history of goiter in their mother, 2 in their grandmother, one in a brother and a cousin, and one female, P. M., aged eighteen years, stated that her seven sisters were likewise goitrous.

Pregnancy. Of 140 women 45 had deliveries one or more times. Lactation histories are unknown. Five women noticed their first symptoms while pregnant. Many had borne children subsequent to treat-

* Read at the staff meeting of the Moses Taylor Hospital, April, 1934.

ment. In no instance was there evidence that gestation or lactation caused a recurrence or initiated thyroid phenomena.

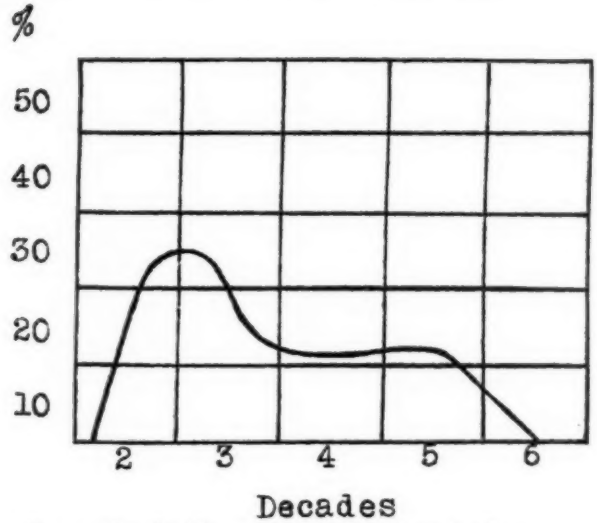

Fig. 1. Age incidence percentage of non-toxic cases.

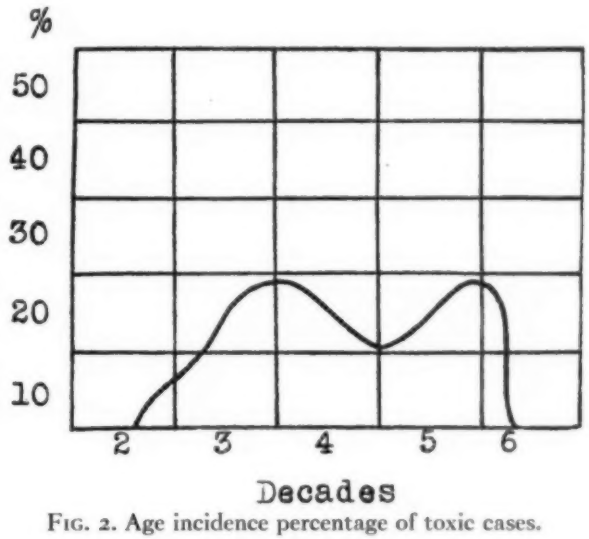

Fig. 2. Age incidence percentage of toxic cases.

Duration. Six years was the average duration of the non-toxic and four years of the toxic goiters respectively. One woman of forty-six years gave a history of thyroid enlargement for thirty years. Much of the gland was calcified. Three patients suffering from thyrotoxicosis dated the onset more than fifteen years, one twenty-five years previous to admission. Either these latter had a recent hyperactivity of a chronically enlarged gland, secondary hyperthyroidism, or mild exacerbations followed by intervals of remission. An example of acute thyrotoxemia was J. O., aged forty-two years, who believes the onset followed immediately his suffering severe burns eight months before entrance to the hospital. Three and four weeks respectively elapsed after onset in the earliest instances in which patients sought medical attention.

Symptoms. Swelling was the most constant feature; it was present in 93 per cent of all cases. Thirty-four per cent of all patients, including 29 per cent of the toxic group, complained of pressure. Twenty per cent were nervous of whom 9 per cent, or approximately one-half the total number were toxic. Nervousness marked 64 per cent of all toxic cases; 39.2 per cent of these latter complained of palpitation; 35.7 per cent of weight loss; 21.4 per cent of exophthalmos; and 10.7 per cent of gastro-intestinal symptoms. Mental or psychic disturbance was present in only one instance. Eight and two-tenths per cent of the non-toxic patients complained of palpitation, but no cardiac disturbance was found clinically.

Operation. It was possible to determine the type of operation employed in 191 cases. There were 78, or 38.4 per cent, subtotal thyroidectomies; 56, or 27.5 per cent, lobectomies; 47, or 23.1 per cent, tumors excised and 10, or 4.9 per cent, ligations.

Anesthesia. The 191 operative records reveal that the following anesthetics were used, ether, 99; nitrous oxide-oxygen, 42; nitrous oxide-oxygen with stovaine infiltration, 18; procaine infiltration, 18; nitrous oxide-oxygen with procaine infiltration, 9; not stated, 4; and one mixed narcosis, chloroform-ether-nitrous-oxide sequence demonstration by Dr. Gwathmey. Forty-eight and seven tenths-per cent were given ether and 20.6 per cent nitrous oxide-oxygen. There were no deaths directly attributable to the anesthetic employed, although one patient, E. S., aged fourteen years, who had definite pressure symptoms, died while under the influence of ether, death resulting from respiratory failure; her heart continued to beat for five minutes after breathing stopped. Tracheal collapse

was suspected. Unfortunately, autopsy was not permitted.

Bleeding. Unusual bleeding was observed in 10 patients anesthetized with ether, 3 with novocaine infiltration, 2 with nitrous oxide-oxygen and stovaine infiltration, one with nitrous oxide-oxygen and one with nitrous oxide oxygen-ether. Of the 8.5 per cent who bled freely, 5 per cent were given ether; the remaining 3 per cent comprise 6 patients, 4 of whom were given nitrous oxide-oxygen alone or supplemented with local infiltration. Since there is no control for this series, it is impossible to condemn ether on these figures only. One death resulted from primary shock and hemorrhage several hours postoperatively. This patient, L. R., aged forty-seven years, had a very difficult operation for nodular non-toxic goiter that was so extensive as to require resection of the left sternoclavicular joint under deep ether narcosis. Two others who had ether developed postoperative hematomas that required heroic intervention.

TABLE I
COMPARISON OF INITIAL COMPLAINTS

Non-toxic			Toxic		
Number	Complaints	Per Cent	Number	Complaints	Per Cent
89	Swelling	52.9	4	Swelling Exophthalmos	14.2
53	Swelling Pressure	31.1	3	Swelling Palpitation Nervousness Weight loss	10.7
7	Swelling Nervousness	4.1	3	Swelling Pressure Nervousness	10.7
5	Swelling Nervousness Palpitation	2.9	2	Swelling Palpitation	7.1
3	Swelling Nervousness Palpitation	1.7	2	Swelling Nervousness Headache Vertigo	7.1
3	Pressure	1.7	2	Sweating Hot Flashes Insomnia	7.1
3	Swelling Nervousness Palpitation Pressure	1.7	2	Swelling Palpitation Exophthalmos Weight loss	7.1
2	Swelling Nervousness Palpitation Sweating	1.2	2	Swelling Pressure Nervousness Sweating	7.1
2	Pressure Headache Vertigo	1.2	2	Swelling Nervousness Palpitation Weakness Weight loss	7.1
1	Pressure Headache Vertigo Nervousness Hot flashes	0.5	2	Nervousness Palpitation Nausea Vomiting	7.1
1	Swelling Vertigo Nervousness	0.5	1	Vertigo Swelling Nervousness Headache Vomiting Dyspnoea	3.5
1	Pressure Nervousness Vertigo Palpitation Weakness Vomiting	0.5	3	Weakness Nervousness Pressure Weight loss	10.7

Mortality. The total number of deaths from all causes in this series, as shown in Table II, was 14, or 6.8 per cent. One of these, L. D., aged thirty-seven years, came to the hospital with a terminal cardiac decompensation and was not operated upon. She died fifteen days after admission of cardiac dilatation superimposed upon mitral disease. Postmortem sections of the thyroid gland were typically those of diffuse hyperthyroidism. Another patient, J. M., aged forty-two years, died five years after operation, the result of malignant pulmonary metastasis. Neither of these deaths should be considered in the surgical mortality statistics. The remaining 12 records, 5.8 per cent, represent deaths that

TABLE II
TOTAL MORTALITY

Age	Sex	S. St.	Lesion	Death	Cause of Death
14	F	S	Dif. N. T.	On table	Shock & hemorrhage
14	F	S	Dif. N. T.	37 das po	Pulmonary embolus
19	F	S	Nod. Tox.	3 das po	Crisis
20	F	S	Dif. Tox.	4 hrs po	Crisis
21	F	S	Dif. N. T.	9 das po	Collapse of trach.
29	F	M	Carcinoma	5 wks po	Rapid recurrence
33	F	M	Nod. N. T.	4 hrs po	Collapse of trach.
37	F	M	Dif. Tox.	No oper.	Cardiac dilatation
38	F	M	Nod. Tox.	5 wks po	Mil. absc. of lung
41	F	M	Dif. Tox.	Post op	Shock & hemorrhage
42	M	M	Carcinoma	5 yrs po	Pulmonary metast.
43	F	M	Nod. Tox.	Post op	Myocardial failure
54	F	M	Dif. N. T.	Post op	Myocardial failure
62	M	M	Carcinoma	2 das po	Collapse of trach.

occurred directly or indirectly following surgery. Of the indirect deaths there are 3 or 1.4 per cent; one resulted from pulmonary embolism thirty-seven days after operation, another of miliary abscesses of the lung thirty days postoperatively and a third from strangulation due to a rapidly growing recurrent carcinoma five weeks after an attempt at surgical removal. The direct surgical mortality is 4.3 per cent for all cases and 4.4 per cent for all operations of this series.

Radiation. Radiation therapy was used on 5 benign goiters. In 4 of these the results were disappointing and operation was advised. One patient was treated with radium in 1927. When seen on recall August 23, 1932, she was distinctly thyrotoxic. The only patient in this group who showed response was C. W., aged twenty-seven years. In spite of a superior pole ligation she grew more toxic constantly and *x*-ray therapy was tried in preference to further surgery. On recall in July, 1932, twenty-one years after treatment, she was found completely well except for rather marked skin telangiectasis.

Carcinoma. The 6 records of malignancy outlined in Table III represent 2.9 per cent of our thyroid cases. The youngest patient affected was twenty-nine years, the eldest seventy-five years and the average age incidence was fifty years. The immediate surgical mortality was 33.3 per cent.

TABLE III
MALIGNANT THYROID CASES

Age	Sex	Treatment	Result	5 Year Cure
29	F	Radical op.	Died p.o.	No
42	M	Radical op.	Died	Lived 5 yrs.
43	F	Operation + *x*-ray	Cured	Yes
49	F	Operation + *x*-ray	Improved	Alive
62	M	Radical op.	Died p.o.	No
75	M	Operation + *x*-ray	Cured	Yes

One patient lived slightly longer than five years after operation. Seen on recall shortly before death, he was found to have metastasis to the lungs and a large substernal and subclavicular tumor. Three patients, or 50 per cent, are alive and well, 2 more than five years and one more than four years after operation. These latter were treated by extensive *x*-ray therapy after operation. There remain 33.3 per cent five year cures, not counting the patient who died as indicated above, shortly after five years. Malignancy was equally distributed as to sex, and the operative mortality was likewise equal.

Chronic Thyroiditis. Chronic idiopathic or non-specific thyroiditis, commonly called Riedel's struma, a benign granuloma, is of rare occurrence, is iron hard, and before operation the usual diagnosis is carcinoma. The onset is insidious and there are no complaints until swelling is sufficient to produce pressure symptoms. A case representing this condition is as follows, T. C., aged forty-eight years, noticed a swelling of the left side of the neck thirty-three years before admission. Growth was slow until three years ago when it became rapid. There were no symptoms, and laboratory findings were negative. A tumor corresponding to the left lobe of the thyroid was found hard, fairly movable and with normal overlying skin. Microscopic sections of the mass removed July 14, 1910, showed "a very marked increase of fibrous tissue which had apparently destroyed all the glandular substance. In several areas there were spaces resembling old thyroid acini filled with bloody and glandular material, but showing no traces of the normal thyroid epithelium." This patient was well when examined three years later.

Postoperative Sequela. It has been said wisely that if one does sufficient surgery he will inevitably experience all the difficulties. Inspection of the following critical survey is convincing. There were 3 wound infections, one adherent cicatrix, one primary hemorrhage, 3 secondary hemorrhages, one tracheitis, 3 tracheal collapes, 2 mild injuries to the recurrent laryngeal nerve, 2 heart failures, one respiratory failure, 2 cases of primary shock, 2 postoperative crises, one embolus, one pulmonary abscess, 2 cases of tetany, 3

recurrences and 2 failures, the latter due to inadequate treatment. One patient who developed tetany was relieved by parathormone and calcium lactate; the other died thirty-seven days after operation from pulmonary embolism. Both patients who showed evidence of nerve injury recovered completely after a short interval.

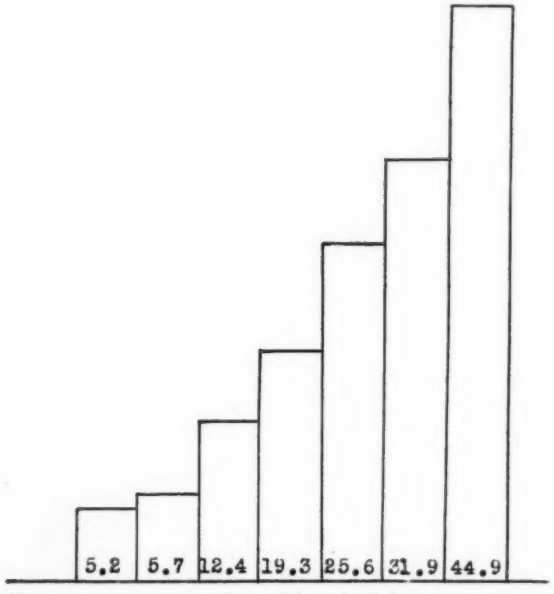

FIG. 3. Average number of hospital days: 5.2 average pre-operative hospital days all cases; 5.7 average post-operative hospital days in uneventful recovery cases; 12.4 average post-operative hospital days for all cases; 19.3 average post-operative hospital days for toxic cases; 25.6 average pre-operative hospital days for toxic cases; 31.9 average hospital days for complicated cases; 44.9 total average hospital days pre-operative and post-operative for toxic cases.

Hospitalization. The number of days of hospitalization varied, depending in large measure upon the following factors, namely, the type and degree of the affection, the condition of the patient when admitted, the plan of and response to treatment, and the complications. Often it was advisable for the individual who lived at a distance to remain hospitalized longer than usual. The introduction of Lugol's solution markedly reduced the interval between admission and discharge of the toxic patient.

Fortunately, most patients were in good general health when received; those who were not were delayed until improved by treatment. In 4 patients it was found that concomitant lesions were present. Two of these, acute rheumatic fever and hypertrophic endomitritis, required primary attention. Two patients who had movable kidney and hernia respectively were operated on later for those conditions.

Easily removed, simple, nodular lesions permitted of discharge relatively soon after operation, ordinarily on the fifth day. One patient was allowed home in three days. However, the average number of postoperative days for all cases was 12.4, the toxic cases averaging 19.3 days. The average preoperative interval for all cases was 5.2 days and for the toxic cases only it was 26.6 days. The toxic cases averaged forty-five days hospitalization. Complications increased the average hospital days to thirty-seven with 31.9 of these spent after operation. Figure 3 graphically compares the pre and postoperative hospital intervals for the various thyroid lesions specified.

Follow-up. Available records permitted the following classifications of the number of cases reviewed, true goiters, 198, of which 28 were toxic. There were in this series 127 diffuse non-toxic, 43 nodular non-toxic, 17 diffuse toxic, and 11 nodular toxic varieties. There was one case of chronic idiopathic thyroiditis and 6 cases of adenocarcinoma.

Of the 138 patients who were examined one or more years after treatment only 2 showed failures, an incidence of 1.4 per cent. One of these was treated with radium and the other had a unilateral superior pole ligation. Both were advised to return for further surgery.

Exclusive of the carcinoma cases and the case of thyroiditis, there were 131 true goiters with follow-up records in this series. One hundred thirty were treated surgically with complete relief in 129 patients.

SUMMARY

Although the major problems of thyroid disease as encountered in the smaller

hospital are relatively the same as those met in the larger institution, minor differences in the management of thyroid cases may result in major consequences.

Critical judgment of the merit of any therapeutic measure predicates an intelligent evaluation of the ultimate benefit to the patient; and an appraisal of the results of a method of procedure is best derived from adequate and systematic follow-up studies. A thorough review of case records furnishes a complement of experience that can be attained in no other way. Such review combined with meticulous examination of surviving patients literally brings the thyroid surgeon to judgment.

Provision for follow-up studies is lacking almost universally in smaller hospitals. Professional apathy notwithstanding, there are many obstacles which tend to preclude the issue of reviews from hospitals with fewer than 100 beds. Because of these faulty circumstances, much valuable knowledge is not forthcoming, morbidity and mortality data are inaccurate and there are many surgeons with an unwitting concept of their work and its results.

The 205 cases reviewed in this study accumulated over a period of thirty years; and although most records were complete a number could not be utilized because much of the necessary information was not recorded. From the details available it was learned that:

The diffuse forms of goiter in both the toxic and non-toxic groups have an earlier age incidence than the nodular forms. The diffuse toxic goiter appears predominently a decade later than the diffuse non-toxic variety. There is not an appreciable difference in the age incidence of the nodular non-toxic and the nodular toxic goiters. Malignancy of the thyroid gland is most common after the fourth decade of life and it usually follows a preexisting nodular goiter.

As generally understood, and corroborated in these studies, females are more frequently affected by thyroid disease than males. The sexes are affected equally with cancer of the thyroid gland.

Except for the examples of acute thyrotoxicosis, symptoms are of comparatively long duration, averaging approximately five years. Swelling is the most constant complaint. Pressure is complained of more commonly by toxic patients. Nervousness, palpitation and weight loss are not confined to toxic cases. Exophthalmos is approximately twice as frequent as gastrointestinal complaints in thyrotoxicosis.

Evidence is inconclusive as to any deleterious effects resulting from the various anesthetic agents used in this series.

Preliminary ligation of the thyroid arteries is not an absolutely safe procedure and is increasingly giving way to operative attacks on the gland in one or more stages. Subtotal thyroidectomy is the operation of choice, although single adenomatous nodules may be removed locally.

Postoperative complications are usually of serious consequence and require immediate, often heroic, treatment. Complications markedly increase the period of hospitalization. The proper use of iodine pre- and postoperatively in toxic cases greatly reduces the incidence of complications and likewise shortens the period of hospitalization.

The mortality rate in goiter surgery is higher in smaller hospitals. It is presumed that the mortality rate, 5.8 per cent, in this series closely approaches the average for thyroid cases in the smaller institution, a major consequence. The immediate surgical mortality rate in cancer of the thyroid gland is much higher than that of other surgical conditions of the gland.

Surgery offers the greatest probability of cure in both non-toxic and toxic goiter; and should be supplemented with radiation therapy in the treatment of thyroid cancer.

A deep personal obligation is acknowledged to the late Dr. J. M. Wainwright for the privilege of examining these patients, for the unrestricted access to his records, and for the privilege of publishing this review.

INFECTIONS OF URINARY TRACT*

MODERN METHODS OF TREATMENT

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INFECTIONS of the urinary tract have been a source of annoyance and study long before the world ever heard of urologists. In the early years of medicine a pyuria was considered of distinct value as carrying off certain inflammatory conditions in the body, not particularly in the urinary tract. Much has been written and a great amount of investigation done in the last five years, particularly in dietary régimes, to combat those stubborn conditions so well known to us all. The natural tendency of all investigators has been to find some drug which by oral administration would act as a sufficient antiseptic when excreted in the urine, to clear up all infections of that tract. Unfortunately, such an Utopian substance has not as yet been found. The various dyes and other drugs, which give the urine its rainbow appearance, have not merited their extraordinary qualities as described by their manufacturers, and so finally, and at all times, one must return to the simple fundamental rules of medicine and surgery.

In order to come to the point of our subject at once, let us consider for a moment the methods of infection of the urinary tract. It has been proved beyond a doubt that nearly all infections of the kidney are hematogenous in their origin, and that no matter where the original focus lies the ultimate involvement of the kidney is through the blood stream. This is absolutely true of cortical renal lesions. The lymphatic system evidently has little to do with renal involvement because in the first place the lymphatics of the kidney are all of the efferent type and many experiments by MacKenzie and Wallace[1] and others show that this pathway has little or nothing to do with renal infection excepting as absorption by the blood stream takes place. The problem of whether or not infective microorganisms go up the lymph's spaces of the ureter from the bladder and pelvic organs to cause disease of the ureter or kidney has as yet not been decided, despite several efforts to do so by different investigators. When we call to mind the large number of bladder tumors that one sees and the fact that they practically never metastasize into the kidney or ureter, would be against considering the passage of infective material along the same channels. When we consider that the lymphatics of the ureter are segmentary in their character and are divided so that they reach different portions of the ureter, the chances of ascending infection along these channels is considerably nullified. Robinson[2] claims that the lymphatics of the lower third of the ureter empty downward and if we are to take this fact into consideration, infection from below upward by this means is doubtful.

In speaking of kidney infections we recognize practically three types: (1) pyelitis, (2) pyelonephritis, and (3) pyonephrosis. I feel that the condition known as pyelitis must of necessity be a very transitory one because if it actually exists, separate and alone from the other types, it must be an ascending infection. Relatively no pyogenic organisms can come through the kidney from the blood stream without first causing inflammatory changes in the cortex or parenchyma before reaching the pelvic mucous membrane. If, perchance, the infection may be of the ascending type either through the lumen of the ureter, ureteral wall or perivascular lymph stream,

* From the Department of Urology, Bayonne Hospital, Bayonne, N. J. Read at the Meeting of the Northwestern Ohio Medical Association, Findlay, Ohio, June 2, 1936.

such infective material is immediately soaked up by the mucosa of the renal pelvis and is carried back into the kidney itself, thereby causing inflammatory changes which may or may not go on to further destruction of the kidney substance. If one doubts the absorbility of the pelvic mucosa, I would suggest putting 5 c.c. of indigocarmine solution into it through a ureteral catheter and watch its appearance from the other kidney which will be in almost the same length of time as if given intravenously, that is, providing, of course, that both kidneys are normal. Therefore, I have held as my opinion for a long time that an actual pyelitis alone, by itself, is a clinical and a pathological rarity.

Pyelonephritis tends to be more of a chronic condition of the kidney and is usually observed in conditions of urinary stasis and renal calculous disease. We refer to it as a chronic inflammatory disease where changes take place mostly in the pelvis and parenchyma of the kidney without abscess formation. As a rule correction of the condition which causes it will, unless the disease is too far advanced or of tuberculous origin, show a considerable return of functional activity. This is particularly true when calculous disease is present.

Pyonephrosis means exactly what the name implies; a breaking down of the renal tissue into abscess formation with communication of the pyogenic material to the renal pelvis and the urinary stream. This is not always true of some of the cortical infections which quite frequently show no connection with the urinary stream but rupture externally into the perirenal space to cause a perinephritic abscess. The absence of pyuria in these conditions may lead to confusion in diagnosis.

Parenchymatous infections of the kidney whether tuberculous or not require nephrectomy if cavitation has taken place, as no other type of treatment will heal kidney tissue when abscess formation of any size actually exists. This is probably due to the peculiar soft glandular structure of the kidney and also to the irritating effects of the urine which constantly bathe such a pathological process. When one or more fair sized cavities exist in a kidney it is doomed to destruction, despite any type of therapy now available.

Infection of the ureter, except by tuberculosis or some other type of severe pyogenic disease, is not a particularly frequent condition. It may become grossly altered by the presence or the passage through it of renal calculi, or have strictures, angulations or renal ptosis, but otherwise it is fairly immune to infection. We have, however, noted several instances of ascending infection which appeared to be due to inflammatory conditions of the tubes, or ovaries in the female and the prostate and seminal vesicles in the male.

The ureter being in a position between the kidney and bladder is liable to infection from either of these organs, mostly by the actual contact of infective material. From the kidney above this takes place very easily because of the natural flow of the urine downward. From the bladder upward it is more difficult and with a ureter with whose peristaltic wave there is no interference and whose lowermost segment still retains its normal contractility, ascending infection is quite unlikely to happen. Destruction of the normal contractility of the ureter, particularly the sphincteric action of the intramural vesical segment by such conditions as neoplasm or enlarged prostate allows ascending infection to take place easily.

The bladder is an organ which if left alone rarely ever becomes infected, its pathology being in nearly every instance presented to it from the kidneys above or from the urethra and genital organs below. Therefore it at once stands to reason that treatment of a bladder infection means treatment of the organ causing it.

It is well to remember, as stressed by Cumming,[3] who says,

> The entire urinary tract is a tube with a strong muscular wall, functioning by means of typical smooth muscle peristalsis for the

purpose of disposing of the urine after it is taken away from the kidney. This muscular wall is subject to various congenital and acquired anomalies, as well as to the ravages of infection. The basic factor is a sensitive mucosa-lined muscular excretory pathway, which is in constant physiological activity, waging a defense against ever-recurring infective agents, . . . so that finally he says . . . all acute infections of the mucosal structures (of the urinary tract) are irritative first, later paralytic, and gradually, in chronic stages, tend to produce atony.

In treating infections of the urinary tract there is one cardinal rule that must ever be in mind and that is there is no treatment of a urologic infection without adequate drainage. It is not always necessary to remove a urinary organ for disease but its return to health is assisted and in some instances obligates adequate drainage or short circuiting of the urine; for instance, a badly infected kidney may be brought back to a fairly normal existence by the early application of a proper nephrostomy drainage. The bladder when grossly infected as a result of calculous disease, stasis of urine from an enlarged prostate or vesical neck contractions must be first drained by a suprapubic opening before anything is done to correct the offending pathology. It takes but very little urine to cause most profound infective results, as may well be noted when extravasation of urine takes place into unaccustomed tissues.

In treating infections of the urinary tract one is faced by conditions not usually found in any other part of the human body because of the fact that the urinary organs are so frequently the seat of congenital anomaly. Urologists are continually balked in their treatment by finding congenital conditions that have caused extreme dilatation of the renal pelvis, ureter and bladder, and when the latter is affected primarily, it may cause extreme changes to take place in both ureters and kidneys; therefore it stands to reason that any successful treatment of urinary infection must preclude a knowledge of such conditions, for if strictures are present in any part of the urinary tube, treatment of any kind will be of little avail until appropriate dilatation is accomplished. In such conditions as pyonephrosis, whether tuberculous or not, calculous disease, extreme hydronephrosis, renal tumor, hypertrophied prostate, diverticulum of the bladder and any condition where infection appears to be the chief urinary symptom, adequate, corrective surgical measures must be undertaken and the folly of any other type of treatment is apparent.

The presence of pyuria accompanying anomalous conditions of the urinary tract in children has been mentioned by many and particularly by Bigler,[4] Heppler and Scott[6] and Campbell,[5] who aptly remarks that some children are born with pyuria, others achieve it (usual clinical event), while others have urinary infection thrust upon them (instrumentation introduction).

Therefore it is well to stress the point that although a thorough bacteriological examination of the urine should be at once carried out, yet it is also apparent that a thorough knowledge of the physical condition of the urinary tract is as necessary.

One should never forget certain of the metabolic diseases which appear to lay open an easy road to urinary infection. An example of this is found in diabetes. Sharkey and Root[7] made a clinical pathological study of the incidence of urinary infections in 196 diabetic cases; 18 per cent revealed at autopsy evidence of urinary tract infection, 70 per cent of which were evidently of the hematogenous type secondary to infection elsewhere in the body. They drew one's attention to two other important matters. The first being the avoidance of catheterization, if possible, in diabetes, and secondly, that unexplained fever in adults may possibly be due to urinary tract infection. We heartily coincide with this advice.

Infections of the urinary tract have been caused by nearly all the pathological microorganisms that infest the body, so that in outlining any method of treatment it is very necessary to determine the offending

germ at once. Such a course not only gives one the satisfaction of knowing just what type of microorganism is the relevant one but gives immediate lead to the appropriate treatment by which the patient may be cured in the shortest space of time. One must insist then that this is the first procedure in treating any urinary infection, i.e., a careful laboratory study and culture of the infective agent. Innumerable examples of this may be cited, for while it is true that sooner or later the colon bacillus usually creeps into every urinary infection, still in the early stages a recognition of the coccal and proteous groups would have been of great benefit in administering a cure. Therefore we stress the importance of finding the offending germ, then tracking down its source and finding out what damage it has caused in the urinary tract and what factors make for its non-expulsion.

In carving out actual treatment of an urinary infection when presented by a patient, one must pause at first and consider most carefully whether it is acute or chronic, for it is quite certain that the phase of the disease makes for great differences in therapeutic measures. Acute infections are usually characterized by chills, hyperpyrexia, pain in the affected area, marked malaise and oliguria, while chronic conditions may have only the irritative effects, such as frequency, dysuria, anemia, anorexia, loss of weight and lassitude. In an acute infective process there are two outstanding steps to be taken at once. The first is to make as careful a roentgenographic study of the patient as possible. This had probably be best accomplished by the intravenous urogram. It is essentially necessary to know something about the kidneys, ureters and bladder before starting any type of treatment and thus it may be quite possible to demonstrate calculous disease, hydronephrosis, the comparative functional ability of each kidney and various types of obstructive stasis, enlarged prostate and some of the more gross lesions by this means. It may even point out a non-functioning kidney on one side as a lead to diagnosis. A cystoscopic examination with ureteral catheterization and pyelogram is not usually to be recommended in acute urinary infections but we have in the preliminary *x*-ray and intravenous urogram a means of showing a fair amount of urinary pathology. This procedure may indeed be carried out by most general practitioners.

The other step in diagnosis should be started simultaneously whether the condition is acute or chronic, and this is a careful bacteriological study of the urine which must include culture and sometimes repeated culture.

It is a common fallacy that all urinary conditions, even other than infections, should receive a large water intake, and patients are filled up by oral drinking, clyses, or even intravenous administration. This should be carried out only in the acute infective conditions and is best given by the intravenous, constant drip method. Five per cent glucose in normal saline is the sheet anchor of therapy. It increases the flow of urine, aids in washing out the renal tubules, helps the temperature to drop, moistens the skin and tongue and gives the patient an improved outlook on life. The same material by clysis is next best from the therapeutic standpoint and is to be employed when the intravenous method is not available or dangerous on account of improper conditions. Drinking large amounts of water does not seem to have the desired effect as a rule, because of the danger of nausea and gastric dilatation. In chronic infective conditions, it is often of value to suspend the water intake which will be of valuable aid in increasing the concentration of the urine and lowering its *pH*.

The intravenous administration of methenamine in large doses, as found in the ampoules now on the market, appears to have a decided beneficial effect. Studies by Davis and Sharpe,[8] Helmholz,[9] Gillespie[10] and others have proved beyond a doubt that methenamine is the only substance in the long lists of drugs by bodily ingestion for the control of urinary infection that is

of any value. In fact Davis says, "in the treatment of infections of the urinary tract, the time has not yet arrived when the old reliable methods, based on detailed investigation and elimination of the accessory or underlying causes, may be discarded in favor of indiscriminate medication. It is likely that this statement will continue to be true long after our knowledge of the subject of internal urinary antisepsis has become more perfect than it is at the present time." The effect of methenamine is greatly aided by a strong acidification of the urine. Patients with either acute or chronic urinary infections should be kept warm and guarded against chilling by open doors or windows blowing directly on them. Absolute rest in bed is another 100 per cent curative agent.

If at this point it can be decided that the acute infection is due to some bladder condition, such as a cystitis from an enlarged prostate or vesical calculus, the next step would be to secure adequate drainage which could probably be done by inserting a retention catheter into the bladder, which at once puts it to rest. Irrigations large enough to distend an acutely inflamed bladder wall must be guarded against and care must be exercised that one is not dealing with an acute gonorrheal posterior urethritis or prostatitis, as acute epididymitis is certain to follow instrumentation of the urethra.

In the early stages of an acute infection, we believe that the patient is more comfortable and excretion will be increased if the urine be made alkaline, but if retention catheters myst be inserted either into the ureter or bladder it is best to acidulate the urine.

If the radiographic studies have revealed calculous disease, particularly if the shadow appears to be in the ureter and causing obstruction with dilatation, infection and absorption into the renal pelvis, then the aid of a competent urologist must be sought, for a catheter must be at once passed beyond the calculus and up into the renal pelvis. An immediate cessation of pain, temperature and chills takes place by the subsequent drainage, and kidneys that showed little or no functional value before will in a few hours return to nearly normal. Such a catheter may be left in the ureter for two to four days if it drips properly and its removal is frequently followed by an expulsion of the stone.

If the bacteriological study of the urine shows a staphylococcus, neoarsphenamine in doses of .35 to .4 gm. should be given intravenously every three days for a few doses, which usually controls it. The streptococcus has no specific curative medicament but one must bear in mind that coccal infections of the kidney are mostly confined to the cortex, as brought out by Bumpus and Meissner,[11] Beer[12] and Culver,[13] and that their origin must be traced back to some distant focus such as the skin, tonsils and teeth.

The largest number of renal carbuncles and cortical abscesses are directly traceable to skin furunculosis; submucous cystitis or Hunner's ulcer is practically always due to a streptococcus. The cortical or coccal infections of the kidney, such as cortical abscess and renal carbuncle in its early stages, are often times extremely difficult to diagnose and are frequently overlooked because of the lack of organisms in the urine. The successful treatment of them after they are well advanced is entirely surgical which means anything from a very simple incision, curettage and incision of the capsule, to nephrectomy.

In the past it has been rather a generalized thought that the successful treatment of bacilluria, particularly that of the colon type, could be controlled by alternate acidification and alkalization of the urine. While such a procedure may have its rewards and might cause a certain amount of benefit and a lessening of the bacteria, yet we have found that the organism soon accommodates itself to the changed conditions and again increases in amount.

The greatest advance made in the last few years in the treatment of urinary infections has been the discovery and application

of the ketogenic diet. Although Barborka, Wilder, Johnson and Helmholz[14] had made studies of the ketogenic diet in its relation to other diseases, it was Clark and Keltz[15] who first put this dietary method on a firm basis for the treatment of bacillary infections of the urine. Helmholz worked on children while Clark treated principally adults. From a perusal of the literature as published by them and others, it would seem to have a somewhat better result in eliminating infection in children. It has been found to have less effect upon the staphylococcus or streptococcus but appears to be almost a specific in destroying the escherichia coli, which fortunately is the germ most frequently found in a pathologic urine. Its bactericidal action depends upon the presence of beta-oxybutyric acid and a rather marked degree of acidity of the urine. Bacterial action takes place only when there is at least 0.5 per cent of the beta-oxybutyric acid and the *p*H of the urine must be below 5.5. This is the low limit of bactericidal action. Any increase of the acid percentage and a corresponding decrease of the *p*H of the urine increases the bactericidal power of the latter.

The drawbacks in the administration of this diet are considerable and the great increase in the fat content of the food frequently causes gastric upsets to the patient and a refusal to continue longer; however, we agree with Clark that there is no halfway rules to success, or as he aptly expresses it, "there is no such thing as a 90 per cent ketogenic diet." It must be 100 per cent or nothing. This led Nesbit and his co-workers[16] to suggest a different modus operandi. He says,

> it has long been recognized as a fundamental principle of metabolism that the organism is not dependent upon exogenous fat for its metabolic mixture, calling upon its endogenous supply whenever the energy of the diet is below the expenditure of the energy. This being true, the production of ketosis is solely dependent upon an inadequacy of available glucose. This must be supplied from exogenous sources. In starvation, where the caloric requirements of metabolism are almost entirely dependent upon the utilization of endogenous fat, one sees the most rapid and profound degree of ketosis.

The dietary régime as laid down by Nesbit is much easier for the patient and appears to serve as good a purpose. Any diet that will give a concentration of beta-oxybutyric acid 0.5 per cent in the urine accompanied by a *p*H 5.5 is all that is needed to obtain a bactericidal product.

One of the drawbacks of the ketogenic diet is the fact that efficacy depends to a considerable extent upon the functional capacity of the kidneys and if there is interference with it in any way, ketosis in the urine is difficult to obtain; therefore in the instance where one is most desirous of obtaining a bactericidal urine, the very fact that the kidneys are damaged may prevent such an occurrence. It is also well to bear in mind that if the infection is relegated to one kidney it is quite necessary to catheterize the ureters and obtain the urine from the pathologic kidney for examination, as the total urine could not possibly represent the bactericidal status of the urine from the damaged kidney. In obtaining sufficient acidity of the urine the usual substance that has been recommended to be taken by mouth is ammonium chloride which appears to act possibly quicker and better than other acidifiers, however, one must be careful in the presence of a Proteus vulgaris infection, particularly where calcification or incrustation has formed in the urinary tract. Because of the urea splitting-ability of the proteus, it is practically impossible to acidify the urine in the presence of ammonium chloride and the incrustations may become greater. In such conditions a different type of acidifier should be used. Sodium acid phosphate is often sufficient or nitrohydrochloric acid, as recommended by Crance.[17] The increase in systemic acidosis causes an increased amount of calcium and phosphate to be excreted in the urine which creates a condition somewhat analogous to hyper-

parathyroidism. The action of the proteus bacillus in producing a large amount of ammonia in the urine thereby rendering it strongly alkaline will certainly cause an increase in the incrustations. This actually occurred in a patient as reported by Chute.[18] Such a fact must be borne in mind particularly when one is considering the treatment of bilateral calculi by the ketogenic dietary régime.

A treatment as outlined by Crance which he calls his four point treatment appears to cover the field quite thoroughly and is made up as follows: (1) giving of an autogenous vaccine; (2) daily enema to eliminate the colon bacillus; (3) Bacillus acidophilous by mouth; and (4) two weeks of high protein diet; two weeks of high fat diet; two weeks of high carbohydrate diet.

The results of the ketogenic diet upon actual interstitial and inflammatory conditions of the kidney are still sub judice. Naturally a bactericidal urine must come into direct contact with the offending organisms in order to kill them and such an event taking place within the kidney tissue itself is perhaps doubtful. It is probable that the ketogenic diet will prove to be of most value in the chronic and recurring types of urinary infection.

In view of the fact that the bactericidal power of the urine is dependent to a great extent on the presence of beta-oxybutyric acid, Cook and Braasch[19] decided to give this substance by mouth in an effort to increase the amount in the urine. They found that when the patients were in a state of ketosis that there was actual excretion of the drug and a definite increase of it in the urine. In those patients where ketosis had not been obtained there was no excretion of the drug. Rosenheim[20] has shown experimentally that mandelic acid has as great a bactericidal action in the urine as beta-oxybutyric acid and that it can be given by mouth, and is excreted unchanged in the urine. This led Helmholz and Osterberg[21] to experiment with it in a certain set of patients with a like result, so that the future may hold for us the possibility of actual drug ingestion without the necessity of so much trouble with dietary régimes.

One of the grave dangers that is liable to slip in by an indiscriminate use of the ketogenic diet is that some real serious pathological condition which needs prompt and efficient surgical treatment such as, for instance, tuberculosis or calculous disease will be overlooked.

Although theoretically the ketogenic diet seems to fill a long-felt want in the armamentarium of the urologist, yet I was much surprised in going over the records of my hospital service in the past two years to find in how few instances we had used it.

We are all quite familiar with the distressing condition which happens so often, particularly in the female, in that certain patients complain of recurring attacks of severe bladder symptoms, such as frequency, dysuria and tenesmus, with often times a terminal hematuria, owing to the extreme severity of the latter symptom. I am quite convinced that these conditions are due to a chronic urethritis with great proliferation of the mucous membrane, which usually goes on to cystic degeneration. These masses of cysts in the posterior urethra harbor large numbers of bacteria and some exciting agent frequently lights up this chronic condition with the resultant, acute, inflammatory symptoms. The original beginning of much of the urethritis, trigonitis and cystitis in women is due to the actual infection of the urethra by improper methods of cleaning after stool. A cure of such conditions can only be accomplished by proper hygienic instruction and a thorough dessication of the cysts by the high frequency cautery. Winsbury-White[22] in England and Herrold[23] have drawn attention to the relationship between inflammatory conditions of the cervix and the extensive changes which take place in the mucosa and submucosa of the urethra and trigone. They show remarkable improvement in bladder symptoms following adequate cauterization of the cervix and endocervical canal.

Bacteriophage in the treatment of the urinary infections has been disappointing. To some extent this may be due to the extreme caution necessary in the technical preparation and administration of the phage. This point was brought out particularly by MacNeal, Frisbee and Applebaum[24] as well as by Wehrbein.[25] The fact that the phage must be brought into direct contact with the infective organism to be of any benefit whatsoever, immediately brings up a considerable mass of technical difficulties. While several brilliant results were obtained by us at the New York Post-Graduate Hospital, yet on the whole treatment was far from satisfactory but we believe with MacNeal that it has great possibilities.

The newly established fever therapy for urinary infections has crystallized itself practically to the treatment of gonorrheal conditions. It appears to be a form of treatment which requires very special apparatus and a like character of training in order to administer it. Some of the results obtained appeared rather startlingly good but it is a treatment of such a heroic character that very few patients will be found with courage enough to continue it.

The treatment of chronic infections of the urinary tract belong principally to the specialist in urology. It often times takes days and even weeks of careful technical study to ferret out the exact pathological condition existing. In chronic infections there is usually no necessity to hurry and in fact the urologist who takes plenty of time to study his patient thoroughly will be more apt to find out the exact condition from which his patient is suffering. After one has made a correct diagnosis, the treatment is usually well established, which is a condition existing in practically all branches of medicine and surgery.

SUMMARY

The necessity of studying and determining the exact infective agent causing the urinary pathology before any type of treatment would be offered, is stressed. The various drugs and other accessories in treatment are discussed, particularly that relating to the use of the ketogenic diet.

Nothing more than a mention has been made of the treatment of urinary infections with mandelic acid. This substance is being used under supervision by well known clinicians and bacteriologists and until their final report is made the indiscriminate use of the many preparations of mandelic acid now on the market should be discouraged.

Sulfanilamide in various disguises is a substance much recommended in coccal infections anywhere in the human economy. It has been used with signal effect in urinary tract conditions. Its dangers have not been fully evaluated and therefore it has not been considered in this paper. It needs the seasoning temperament of time and study.

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Education is from within. It cannot be poured into you with a soup spoon.

The heart is the only organ that takes no rest. That is why it is so good.

The brain is our pacemaker.

The diseases of old age are the diseases of children—grown old.

Business worries do not start the endocarditis.

Cohnheim has said: "Men do not develop pulmonary edema and die; they develop it because they are dying."

Read more Adami; he was the last of the thinking pathologists.

Wait for the public to make you a specialist—don't anoint yourself.

Don't chide the state-Mediziners—they only hold that practice is a grocery store business.

Chemistry remains the purest of the sciences because it most consistently dumps the impurities down the sink.

CASE REPORTS

ACUTE FREE PERFORATION AS FIRST SIGN OF REGIONAL ENTERITIS

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IN reviewing the literature from October 1932, when Crohn, Ginzburg and Oppenheimer first described the syndrome known as regional ileitis, until the present date, the occurrence of acute free perforation as the first sign has never been noted clinically heretofore.

In fact we have been able to find only one other case of free perforation, that of Arnheim, 1935, and this occurred in an individual who gave a history of diarrhea for ten years and abdominal pain for four years previous to admission to hospital; autopsy ten days later revealed free perforation, abscess formation and peritonitis.

In presenting the following case, there are several interesting points for discussion: (1) absence of symptoms previous to perforation in contrast to pathology found; (2) onset with pain in the back; (3) presence of an organism found in pure culture in the peritoneal fluid; (4) the various phases of the disease occurring within a short time and finally ending in complete resolution.

CASE REPORT

Mrs. F. T., aged 40 years, female, white, Hebrew, was admitted to St. Francis' Hospital on November 11, 1935, with a history of severe pain in the lumbar region at eight o'clock the previous evening which lessened after the application of heat and massage, and the patient slept well. Next morning she still had pain in the back, but not so severe.

At four P.M. on the day of admission, she was seized with severe cramp-like pain in the abdomen, and endeavored to evacuate her bowels but with little relief. The pain persisted and increased in intensity until five P.M. when she was seen by her physician, who promptly diagnosed the condition as a surgical abdomen and referred her to the hospital. Rectal temperature at this time was 100 degrees and the pulse rate 110.

Her family history and past history were absolutely negative; she had been perfectly healthy all her life, except for a slight indisposition caused by a dilatation and curettage for relief of sterility, twenty years ago.

Physical Examination. The patient was intelligent and sensible. Complained of generalized, severe pain in the abdomen, but no nausea or vomiting was present. Her temperature was 101.4°; pulse rate 120 and she appeared acutely ill. The head, neck and chest were negative. The abdomen was extremely tender all over with slight involuntary rigidity over the entire abdomen. Peristalsis was absent but free fluid was demonstrated.

Vaginal examination was negative, except for exquisite tenderness in both fornices. White blood count showed 26,000 cells with polymorphonuclears 92 per cent, lymphocytes 6 per cent and mononuclears 2 per cent.

Diagnosis. Surgical abdomen, possibly an acute appendix, or, perforated gastric lesion. Exploratory operation determined upon.

Operation. Under general anesthesia, a right rectus incision was made. Free cloudy fluid with large flakes of fibrin was present. The appendix was somewhat reddened and bound down, but obviously not the cause of her symptoms. The appendix was removed. Careful search of the abdomen revealed the free fluid to be all over, in among the coils of the intestine, up under the diaphragm, in the cul-de-sac, etc., and was removed by suction.

The serosa of the small intestine was injected; about eight feet from the ileocecal valve, a loop of gut, 8 to 10 inches long, was found to be definitely hypertrophied, thickened, soggy and rubber hose-like in character. The serosa was blotchy and reddened, with patches of fibrin plastered here and there. The transverse fold was definitely hypertrophied.

The mesentery was definitely thickened and soggy, with multiple small ecchymotic patches present. The mesenteric glands were definitely enlarged.

After a painstaking search, a small linear perforation was found about ¼ inch from the attachment of the mesentery; it was quite difficult to find.

The perforation was closed by mattress sutures and then rolled over into the mesentery and sutured to it. The omentum was wrapped around the inflamed gut and Penrose drains were inserted. The abdomen was then closed. It was felt that in view of the extensive gross soiling of the peritoneal cavity and the fact resolution may take place spontaneously, that resection was inadvisable. Culture was taken from the exudate and planted immediately on the various media.

The patient ran a very stormy course, complicated on the third day by sudden rise in temperature, increase in respiratory rate to 50, cyanosis, and signs of consolidation of the right lower lobe and the left upper lobe. This was followed in two days by acute circulatory failure and again the next day. Bilateral pleural effusion developed and the patient was aspirated on both sides, at two different times. Eleven days postoperatively, diarrhea began with seven stools that day and for twelve days, sixteen watery, brown stools, with blood and mucus present. Diarrhea continued for nine days longer and then was controlled by treatment.

The discharge from the wound was thick, yellow pus, with particularly foul odor, and gradually cleared up.

Proctoscopic Examination. January 2, 1936, the rectum and sigmoid were negative.

Radiographic Findings. December 28, 1935, Examination of the chest shows the thorax to be asymmetrical due to scoliosis of the dorsal spine. The heart was of the oblique type and measures approximately 12 cm. through the transverse axis, which indicates slight enlargement; the normal for this patient is 11 cm.

In the right lung there is an increase in the hilar density with accentuation of the root branch markings in the midperipheral zone and base. The apex, extreme periphery and lower angles were clear. The diaphragm was slightly elevated, especially in its medial portion. There was a dense band, that is believed to represent pleural thickening, which is seen between the levels of the seventh and ninth ribs, posteriorly. The left lung showed a moderate degree of accentuation of the pulmonic markings. The base was partly obscured by the enlarged heart shadow and there is evidence of pleural fluid seen.

Conclusions. The findings of most note are the evidence of slight cardiac enlargement and an increase in the pulmonic markings, probably partly due to the recent acute pathology. There is a dense band of thickened pleura in the right chest with elevation of the right diaphragm in its medial portion.

Examination of the intestines and colon at practically hourly intervals up to the six hour period with subsequent examinations ten, twenty-four and twenty-nine hours after ingestion of the meal, showed evidence of sluggish gastric and intestinal evacuation. There was a small residue in the stomach at the end of the ten hour period. There was a moderate degree of dilatation of the mesenteric intestines in the region of the jejunum, and there were signs of narrowing of the lumen of the tube in the region of the ileum, particularly in its midterminal portion. Evidence of the stasis can be demonstrated in this portion of the intestines beyond the twenty-nine hour period. The cecum was dilated and deformed, probably due to right lower quadrant adhesions. The appendix has been removed. The colon filled and emptied slowly, consistant with the retarded evacuation of the intestines.

Conclusions. The finding of most note is the evidence of narrowing of the lumen of the tube in the region of the ileum, particularly in the midterminal portion, suggestive of a terminal ileitis.

Radiographic Findings. June 3, 1936, examination of the digestive tube with particular attention to the intestines and colon reveals the following:

Observations have been made 1, 2, 3, 4, 5, 6, 10, 25, 29 hours after ingestion of the meal.

In these examinations there is normal progression of the barium mixture through the intestines and colon.

We have not been able to demonstrate any areas of organic narrowing in the lumen of the tube.

There is a slight delay in the terminal ileum beyond the ten hour period, at which time the head of the column is in the rectum and ampulla.

No abnormalities are noted in the contour of the colon.

Conclusions. These examinations of the intestines and colon at regular intervals after ingestion of the barium mixture does not demonstrate any evidence of an organic stenosing lesion.

The only finding of note is the slight delay in the terminal ileum at the ten hour observation.

DISCUSSION

This is apparently the first case of free perforation in the peritoneal cavity to be reported; all others reported have shown the acute inflammatory stage or presented walled off abscesses due to slow perforation. The amount of pathology present was remarkable in contrast to the duration of the symptoms; abdominal symptoms were not present over two hours. The process must have been hyperacute in view of the extensive changes in the intestine (including the perforation which was evidently the result of one of the linear ulcerations along the mesenteric border which are quite characteristic) the mesentery and lymph glands. In all of the cases previously reported, even those that were classified, according to Crohn, et al., under those presenting symptoms of acute abdominal distress, they all had histories of previous abdominal discomfort for a year or more, some as long as ten years; those with abscess formation had the acute symptoms for one to two weeks before coming to operation. This patient has had absolutely no previous symptoms.

The occurrence of pain in the lumbar region about the level of the twelfth dorsal to second lumbar vertebra we think merits some attention. It may be explained possibly on the basis of general toxemia due to absorption, as pain in the back occurs frequently with onset of many acute infectious diseases. On the other hand, its onset as an isolated symptom about eighteen hours previous to the perforation makes us believe it is due to another cause, viz., mesenteric involvement. We have noted in many cases where the mesentery has been involved, either due to inflammatory or mechanical processes, that pain in the lumbar region has been a noteworthy symptom. (We have been collecting a number of cases showing this conclusively, which will be reported later.) In this case, the mesentery was definitely involved before the perforation. Clute also reports pain radiating to back.

In this particular case, we recovered an organism in pure culture and as in most cases previously reported and three other cases of our own, cultures were either negative or considered due to secondary infection. Erb and Farmer describe a bacillus, which they have termed Bacillus W., recovered at autopsy eight hours after death. Culture from liver, spleen, gall bladder, all proved positive for Bacillus W. and they believe that the organism was more important than the usual type found after death. Conclusive proof of the importance of this organism is lacking.

As nearly all observers agree that the condition is infectious and as we recovered an organism in pure culture from the peritoneal exudate, it was decided to study this organism further, for the purpose of deciding whether or not it was the etiological factor.

On smears taken from the exudate, the organism looked like colon bacillus but on further investigation, proved to be the aerobacteria aerogenes.

Description. Aerobacteria aerogenes: identification: Gram negative non-spore forming rods, slightly motile: Dextrose and lactose fermented acid and gas production: Methyl red test, negative: Voges, Prockener, negative.

Presence. Constantly found in milk, and together with one or two other microorganisms is the chief cause of the ordinary

souring of milk. Apart from the occurrence in milk, the bacillus is widely distributed in nature, being found in feces, in water, and in sewage.

Pathogenicity. Pathogenicity for man is slight. In infants it may give rise to flatulence, and has been observed as the sole incitant of cystitis. Among such cases, rare instances have been observed in which it has formed gas in the bladder. Excessive fermentation of sugars with liberation of acids and gas, may possibly be responsible for some cases of diarrhea, but there is no evidence that there is any concomitant increase of ability to invade the tissues among bacilli that take part in this process.

Different strains of the bacillus vary much as to their pathogenicity for animals. Wilde claims that it is more pathogenic for white mice and guinea-pigs than is Freidlander's bacillus. He speaks of it as the most virulent member of this group. Krause rates its pathogenicity as less high.

We may consider this organism in the following light: (1) Its presence in pure culture is the result of contamination of the peritoneal cavity by the intestinal contents and dismiss it as such, or, (2) Has this organism any relationship to this condition? We know that it is commonly present normally in the intestines of man, but, may it under certain conditions have its numbers or its virulence increased, and so produce the lesion under consideration? Its pathogenicity varies with different strains and it is quite virulent for white mice and guineapigs, or, is it possible that soil (the segment of small intestine and mesentery involved) is prepared by a lowering of its resistance by some factor such as allergic, neurologic, dietetic or endocrine disturbances, that the small intestine is rendered susceptible to the normal flora and contents of the bowel? Spastic conditions may occasion conditions of the colon, but there has been but little work done on the roentgenologic examination of the small intestine which may throw some light on the subject in early stages. We have tried, experimentally, to reproduce this lesion in mice, by: (1) feeding the animals pure culture, and (2) feeding both bacilli and roughage to the animals.

White mice have been fed with pure culture over a long period of time with negative results; then, it was decided to feed the culture plus some material which was irritating to the intestine. Accordingly, the pure culture with ground pumice was fed to the half dozen mice. One mouse died and the organism was recovered in pure culture from the peritoneal cavity, although no perforation could be detected in the intestines. This may or may not be considered significant. We are viewing it with an open mind, not stressing it too much, but continuing to try to prove or disapprove whether this organism is capable, under certain conditions, of producing this lesion. We are inclined to say no, but the fact that it occurred in pure culture in the patient and from one mouse, still leaves the question open.

In addition, a vaccine was prepared from the organism and the patient tested for skin sensitivity. It was negative. We also skin tested a number of other patients for sensitivity to this organism, and all were negative.

And lastly may we comment on the rapid changing phases of the disease, within six weeks we had three phases of the disease. Crohn, et al groups them: (1) acute abdominal disease, (2) ulcerative enteritis, (3) intestinal obstruction, and (4) fistula formation.

Here we had first No. 1, then for twelve days No. 2, ulcerative enteritis, followed by signs of No. 3, slight obstruction both clinically and roentgenologically; followed in six months by practically complete recovery, clinically and by *x*-ray examination.

SUMMARY

A case of acute free perforation in a woman with regional enteritis (ileitis) is presented. An organism was found in pure culture which will be studied further, in

order to prove or disprove it as an etiological factor. Note is also made of the onset with pain in the back and the fact that the various phases of the disease may occur within a very short time and complete resolution ensue.

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INVAGINATION OPERATION FOR ESOPHAGEAL DIVERTICULA

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EMBRYOLOGY AND PATHOLOGY

DIVERTICULA of the oesophagus may be divided into two main types.

1. *So-called Pulsion Type.* These occur chiefly in the first part of the esophagus or more truly in the lower part of the pharynx. As the pharyngeal muscles diverge a weak spot is left in the middle line and it is through this area that herniation occurs.

2. *Traction Diverticula.* These occur chiefly in the thorax near the area where the trachea bifurcates. In contradistinction to the pharyngeal type they usually have the orifice or mouth at a more dependent position than the rest of the sac so that these do not tend to cause trouble as do the pharyngoesophageal variety.

The other site at which diverticula tend to occur is at the lower end of the esophagus. These apparently have a different origin. It is my belief that they also are of a pulsion type, associated possibly with some disorder of function of the cardiac sphincter. They may vary greatly in size, some of them being so large as to lead to confusion in diagnosis with hernia of the stomach into the thorax.

Moersch and Judd[1] state that in the etiology a history of goiter or trauma may occasionally be elicited but these seem to be an occasional rather than a true underlying cause. The usual description is that during swallowing considerable pressure is exerted on the wall of the esophagus and pharynx, and the inner coat naturally might be forced through the weakened area between the transverse and oblique fibers of the inferior constrictor muscle. Mayo suggests the possibility of an embryologic or developmental anomaly since several patients complained of difficulty in swallowing since early childhood.

Jackson believes there is an incoordination in the neuromuscular mechanism which results in the failure of the lower part of the constrictor to open when the bolus arrives at this level; this momentarily produces an increased pharyngeal pressure.

Mosher[2] believes there is an embryological background to these pouches because they are normal in certain animals, for example, the pig. In the pig embryo there are two pouches, an upper and a lower, but only the lower, however, persists. It may be noted that there is frequently an asymmetrical development in the two sides of the pharynx; one pyriform fossa, for example, may be obliterated. This asymmetry of the mouth of the esophagus puts the tension on the inferior constrictor off center in swallowing and may readily play a part in the formation of a pouch or hernia.

HISTORY OF EARLY OPERATIONS

Nicoladoni, who was the first to operate on a diverticulum in Vienna in 1877, created a fistulous opening into the pouch. The first successful removal of a diverticulum was performed in 1886 by Wheeler. These early operations had an exceedingly high mortality rate. Stetten in 1910 reported forty-eight cases with 18.7 per cent mortality. This high rate was due primarily to infection.

[1] MOERSCH, H. J. and JUDD, E. S. *Surg., Gynec. and Obst.*, 58: 78, 1–785, 1934.

[2] MOSHER, H. P. *Surg., Gynec. and Obst.*, 60: 403–417, 1935.

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PATHOLOGY

In the case of pharyngoesophageal type of diverticulum the sac consists chiefly of mucous membrane covered by areolar tissue which has herniated out between the muscular fibers. Muscular fibers and blood vessels may extend onto the sac. The sac makes its exit posteriorly but nearly always extends out towards the left side and downwards along the esophagus.

In some instances it may be bound to the esophagus by loose areolar tissue. It is stated that there is difficulty in knowing exactly where the sac begins and where the dissection between esophagus and the sac should be made. This is not true in my experience, the sac being fairly easy to distinguish. A very good way to facilitate this is to have the patient swallow some water at the time of the operation. As a rule this distends the sac readily as a rubber bag would when filled with a heavy fluid. When the sac is emptied by pressure it contracts to only a fraction of its size, showing a marked degree of elasticity. As a rule there is a slight deviation of the esophagus at the neck of the sac so that when food is swallowed it seems to drop into the sac more readily than it does into the esophagus. There may also be a stricture or considerable narrowing of the esophagus at this particular point. Some authors have therefore suggested the patient's swallowing a thread along which a stomach tube is threaded. This more definitely outlines this area at the time of operation. A nasal tube or catheter may be passed into the diverticulum. This has not been necessary in the cases which I have seen.

The point that the writer wishes to emphasize is that the sac is thin and elastic. After the muscle fibers have been peeled off the base and the small blood vessels caught and tied, the sac, being of a semi-elastic nature, has a tendency to contract. This property of the sac explains its contraction after it has been invaginated into the lumen of the pharynx. It shrinks readily and causes no trouble or harm and does not act as a foreign body (see case report).

SYMPTOMS AND SIGNS

Typical symptoms are dysphagia, regurgitation of food, an irritable cough, hoarseness sometimes, and in many cases, particularly in old men, there is loss of weight. A large amount of salivation is also present in most cases.

DIAGNOSIS

The most important method of diagnosis is by *x*-ray, having the patient stand while some barium solution is being swallowed. Thus the filling of the sac can readily be seen. It is advisable to follow the descent of the barium into the stomach and be sure there are not other diverticula or pathology lower down.

Esophagoscopy is of some value but this, as a rule, yields less information than does the *x*-ray picture. Sometimes a lump is felt in the neck to the left of the esophagus, but this is unusual. Where a stricture is suspected the extent of this must be investigated and estimated.

Indications for Operation. The chronic irritation and coughing which produces restlessness, loss of sleep and loss of weight are the chief indications for surgery.

OPERATION

1. *One-stage Operation.* The danger of operation is chiefly that of infection in the deep fascial planes of the neck. It may be recalled that these fascial planes run down into the mediastinum without any anatomical barrier, and if there is leakage from the operative site there may be widespread infection which may travel downwards along these planes and cause generalized infection in the mediastinum with death to the patient. For the surgeon who is operating frequently on this type of case it may be considered reasonably safe to use the one-stage operation.

2. *Two-stage Operation.* For the surgeon who only occasionally operates these cases it is much safer to use the two-stage oper-

ation. The first procedure in this type of operation is to free the sac and elevate it so that it drains by gravity, packing around the sac with gauze to stimulate the formation of adhesions in the fascial planes of the neck. Occasionally this is all that is necessary. The sac in these cases collapses and remains empty, causing no symptoms. In most cases, however, it is advisable to operate again, free the sac and cut it off and suture the base or neck of the sac, and in addition repair the muscular coat over the hernial orifice.

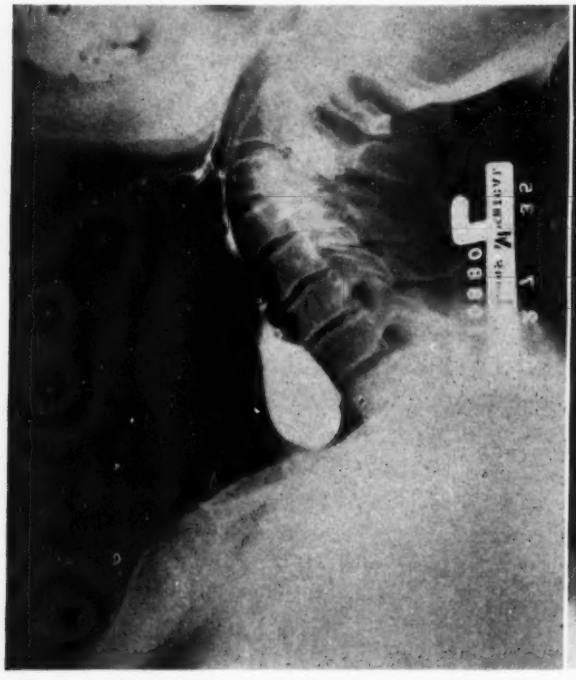

FIG. 1. This illustration shows a lateral view of the sac filled with barium.

FIG. 2. Anterio-posterior view showing the diverticulum filled with barium.

3. *One-stage Operation by Invagination.* The writer wishes to report the following case because the operation was carried out somewhat differently from the above well recognized operations. The method, as will be seen below, is invagination of the sac into the pharynx and repair of the base without cutting off the sac and completing it in one stage.

Mr. H., male, aged fifty-nine years was operated on four years ago for toxic thyroid gland. He had made a good recovery except that it left him with a deficiency of thyroid, the patient requiring to take 1½ grains per day of thyroid substance. The heart was in good condition. The patient was treated for a mild degree of prostatitis a few years ago but at the present time is urinating freely. His blood sugar was 80 mg.; non-protein nitrogen 31 mg.; urinalysis normal; hemoglobin 92 per cent; white blood count 7100. Metabolism on the first occasion was −18 and on the second occasion was −23 per cent.

Present Complaint. For fifteen years the patient noticed some irritation in his throat and a slight difficulty in swallowing which has become increasingly aggravated. The patient's chief complaint, however, was that during his sleep he was wakened several times during the night by the emptying of the sac. As it spilled over, the contents entered the trachea causing spasm and coughing. The patient did not lose weight. Diagnosis was made by *x*-ray, the barium dropping immediately down into the sac, which was about 6 × 4 cm. The opening of the sac appeared to be opposite the cricoid cartilege about the middle line of the neck posteriorly (Figs. 1 and 2). There seemed to be some angulation of the esophagus but this was not a marked feature. The patient swallowed readily and there was no indication of too much narrowing at the orifice of the esophagus. Laryngeal examination revealed no

swelling or edema around the larynx. The vocal cords were normal.

Examination. The patient was healthy in appearance, ruddy complexion, quite alert and active. No thyroid was palpable and no lump in the neck could be noticed or palpated. The blood pressure was slightly low, being 118/90.

Operation. The skin area was blocked off with one per cent novocaine and the nerves along the posterior border of the sternomastoid muscle were injected. Incision was made along the anterior region of the sternomastoid muscle. The fascia was divided along this line and the sternomastoid muscles retracted outwards. The omohyoid was retracted upwards. The carotid artery was palpated and dissection carried medial to it and the carotid sheath with its contents retracted laterally. No thyroid gland was encountered. The middle thyroid vein apparently had been tied previously. The edge of the esophagus was noted and dissection carried along it and the sac was readily made out hanging down into the mediastinum extending to about the second thoracic vertebra. The main part of the sac was about the size of a hen's egg and the neck was somewhat elongated. The sac was stripped upwards out of its bed and was brought up without any special difficulty. It did not seem to be adherent to the lateral border of the esophagus. The patient was requested to swallow water and the sac filled readily and could be emptied easily by pressure. The neck of the sac was about the size of one's index finger and it was noted that a few muscular fibers extended outwards onto its surface. Also a few blood vessels extended out onto the sac quickly becoming smaller. The muscular fibers were stripped off the sac and the blood vessels were caught and tied. The wall of the sac was very thin and semielastic. When the patient swallowed the sac ballooned out to about twice its size and contracted again readily when emptied. The wall apparently consisted of mucous membrane covered by a thin coating of fibrous tissue. When brought into the vertical position it caused a kinking of the esophagus and when the patient was asked to swallow, the sac filled even in the elevated position.

At this stage a nasal catheter was inserted through the nostril and it passed without difficulty into the sac. A ligature was placed around the end of the sac at the level of the eye of the catheter and tied securely with No. 4 black silk, considerable tension being used but not sufficient to cut through the mucous membrane entirely. The catheter was then pulled upon at the nose so as to invaginate the sac into the pharynx. Care was taken not to invaginate too much of the esophageal wall or kink it in any way. No. 0 chromic catgut was then used to sew over the hernial orifice carrying the sutures from above downwards chiefly, closing the hole very effectually. Interrupted sutures of silk were then inserted going laterally a sufficient length to get firm tissue.

The closure seemed to be very satisfactory. The patient was asked to swallow again and it was found that this could be accomplished without any difficulty. A nasal catheter was passed through the other nostril into the stomach without any difficulty and the two catheters were left in situ and the patient returned to bed. He stood the operation very well and the local anesthesia was perfect. The wound was closed, leaving a small Penrose drain.

Postoperative Notes. The first twenty-four hours after the operation the patient was nervous, had a flushed appearance and there was considerable irritation in the throat. The patient brought up fair quantities of mucus and saliva. He was allowed to wash the mouth with saline and bicarbonate of soda to keep this as clean as possible. The patient did not complain of any foreign body being in the throat, the chief trouble being the irritation of the tube in the nose. He was kept in the Fowler's position and he had continuous inhalations of steam with a little tincture of benzoin with great relief. The patient was allowed to sit out of bed after forty-eight hours.

On the third day he was examined with the esophagoscope and a view of the pharynx obtained. It was very gratifying to note that there was practically no edema or inflammation in the pharynx or larynx. Apparently the chief difficulty was with saliva. The sac apparently already had diminished considerably in size and had the appearance of an edematous fold of mucous membrane. It was being held up by the nasal catheter. There was no stricture of the esophagus and no difficulty in swallowing.

Both nasal tubes were allowed to remain in place for six days at which time the patient was complaining of the irritation in the nose occasioned by the tubes. The catheter which had been tied into the sac was pulled upon gently and came away together with the black

silk which had been tied on it. The catheter in the stomach was also removed and the patient was able to sleep at night with the greatest of comfort, not complaining of the slightest irritation in the throat.

Convalescence was uninterrupted from that time, the patient gaining strength rapidly. The Penrose drain in the wound in the neck was removed on the second day, after which the wound healed by first intention. The patient left the hospital on the tenth day. On the fifteenth day roentgenograms were taken. No stricture was noted and there was no evidence of any sac (Figs. 3 and 4). The patient has continued to improve in general health and states that he sleeps without any interruption at night and considers his case cured. It is now nine months since the operation.

McClure[3] reports a case operated in a similar manner but he felt it necessary to cut off the invaginated portion of the sac due to edema. I believe if the cases were carefully selected this would not occur. It is my thought that most cases could be handled this way. Some, however, with thick walls would not be suitable and these could be operated on and excised without invagination.

FIG. 3. Lateral view of the neck taken after the operation showing the absence of the sac on swallowing barium.

FIG. 4. Post-operative. Anterio-posterior view showing the absence of diverticulum as noted in Figure 2.

SUMMARY

1. The author has attempted to review briefly the salient features of esophageal diverticula.

2. A case report is hereby given illustrating a method for inversion of the sac and repair of the orifice.

3. This operation is recommended by the author because:

a. It allows the patient to be operated on at one stage.

b. The sac is not opened so that the danger of infection is minimized.

c. The natural contractile character of the sac causes it to shrink and causes no trouble by its presence in the pharynx.

d. It adds another method of operating which may be used to advantage in selected cases.

e. The patient in this instance has had a very satisfactory result and continues to enjoy perfect health. The author therefore recommends this procedure in selected cases.

[3] McCLURE, R. D., *Am. Jour. Surg.*, 24: 732–743, 1934.

SURGICAL DIFFERENTIATION OF CHOLECYSTIC AND ENTERIC SPASM*

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TYPICAL attacks of cholecystic and enteric spasm may usually be differentiated upon clinical examination with a reasonable degree of certainty. The typical cholecystic spasm characterized by severe colicky pain below the right costal margin radiating to the back or shoulder blade is of such intensity as to require a hypodermic for relief and cannot be confused with any other condition except kidney or ureteral colic, and the localization of the pain serves to differentiate the two.

Enteric spasm located in parts of the abdomen other than the right upper quadrant cannot be mistaken for cholecystic spasm. The problem is only difficult when the symptoms of colic are located in the right upper quadrant and are of a mild degree.

Immediate diagnosis is necessary only if acute suppurating infection of the gall bladder is suspected. The signs of this condition are the usual ones of acute fulminating inflammation in the abdomen, and are localized in the right upper quadrant; namely severe pain, tenderness, particularly when rebound, and muscle spasm associated with elevation of temperature and white blood count. Under these circumstances an immediate operation is, in my opinion, indicated due to the possibility of either a gangrenous gall bladder or an inflamed appendix located in the region of the gall bladder.

However, if symptoms of colic occur without comcomitant signs of severe acute inflammation, immediate operation is not indicated and operation may not be indicated at all.

There is then sufficient time for meticulous accumulation of information and careful interpretation of the facts; the problem becomes a medical one. Either type of spasm is a manifestation of some pathological condition and diagnosis resolves itself into a search for the causative factor, and a definite determination of the contracting part.

The usual causes of cholecystic spasm are infection, adhesions resulting from past infection, obstruction of the duct due to edema of papilla of Vater or calculi.

Enteric spasm may result from a multitude of conditions including cholecystitis. These may be classified into psychogenic, reflex from irritation without and within the intestines, obstructive and systemic conditions causing smooth muscle spasm.

Mental processes and emotions may produce enteric spasm by stimulation of the vagus nerve. External irritative processes cause excitation of associated nerve fibres. These conditions are located in the abdomen or pelvis. The more usual are endometritis, vaginitis, posterior urethritis and cholelithiasis.

Chronic appendicitis is often mentioned as a cause, but I have yet to be convinced that such a condition exists.

Internal irritative processes initiate spasm by irritation of nerve endings within the intestines. A spasm of a distant portion of the intestine may occur simultaneously due to reflex action.

The most frequent conditions encountered are irritation due to rough food or large particles as a result of improper mastication, localized enteritis due to allergic reactions or poisons, frequently alcohol, mucous colitis or other forms of colitis, ulcer of stomach or intestines, hyperacidity, and not uncommonly fissure or hemorrhoids. Obstruction is most fre-

* Read before West Side Clinical Society, New York City. October 8, 1936.

quently due to constipation, but occasionally to scirrhous carcinoma.

Conditions causing generalized smooth muscle spasm are hyperthyroidism, allergy, lead and nicotine poisoning, and occasionally tabes dorsalis.

With all these conditions in mind the search for the causative agent is begun by obtaining a careful history including past medical records of examinations and habits. The physical examination should include the entire patient and not only the abdomen. The general appearance may offer a clue leading to diagnosis.

A short stocky build with wide, thick chest and short abdomen would favor gall bladder disease, whereas a lean type with long abdomen, would be more apt to be affected by peptic ulcer. The state of mind and emotions may also be learned by inspection.

Examination of the abdomen is seldom of value. Definite cases of gall-bladder disease with considerable inflammatory reaction may be detected by the presence of tenderness below the right costal margin; tenderness of the left rectus muscle superior to the umbilicus may indicate enteritis and rarely a spastic coil of intestine may be palpated, but it is unusual for either enteric or cholecystic spasm to produce characteristic changes, demonstrable upon abdominal examination.

X-ray examination is of considerable value and frequently reveals the location of the spasm. The decision upon the type of examination desired depends upon the most likely diagnosis as a result of the preceding investigation.

Other laboratory examinations, particularly an analysis of the stomach contents and of the stool, may be helpful if the diagnosis has not been established.

If the diagnosis is not apparent after these various forms of examination have been completed, one is forced to resort to the process of elimination.

The mental factor can be cared for usually by rest, reassurance and sedatives. The external irritative processes can be ruled out by examination of the systems, internal gastrointestinal pathology by examination of the entire tract, and all sources of irritation by removal of the poisons and the administration of proper bland diet and soothing medicaments. Hyperthyroidism, allergy, lead poisoning and tabes dorsalis may be detected by specific tests and the possibility of nicotine poisoning may be eliminated by preventing its consumption. If following these measures no cause is apparent and attacks of upper abdominal colic continue after a reasonable period of time, one assumes that the cause is cholecystic spasm due to pathological changes within the gall bladder most probably infectious, with insufficient changes to be demonstrable upon *x*-ray examination or clinical examination. I may remark that in my opinion the best form of treatment for this condition is medical as the results following operation are often unsatisfactory. The reason for this I believe to be disturbance of the biliary pressure regulation, a function of the gall bladder. After its removal elevations of pressure are reflected into the liver causing edema of this organ and often an exacerbation of existing hepatitis. As the tone of the sphincter of Oddi is regulated by the action of the gall bladder, removal of this organ causes disturbance of the sphincter. The most usual changes are prolonged spasms resulting in biliary stagnation and increased pressure or continuous relaxation allowing a constant flow of bile into the intestines.

Pribam* has recently described these conditions and it is irrelevant to discuss them in detail.

This all sounds quite complicated but usually there is but little difficulty experienced in reaching a diagnosis. One usually obtains a clue from the history or general appearance of the patient which is confirmed by clinical and laboratory examination. The most frequent causes of colicky upper abdominal pain are gall-bladder disease, with characteristic changes upon *x*-ray examination or enteric spasm due to

* Pribam, B. O. New methods in Gall Stone Surgery. *Surg., Gynec. and Obst.*, 60: 1, 55 (January) 1935.

apprehensiveness, improper diet, eating and drinking habits, gastric hyperacidity or peptic ulcer.

The following case appears to be an interesting example.

CASE REPORT

Patient, aged 44 years, complained of periodic attacks of pain located in the center of the upper abdomen, occurring at intervals of one to three days occasionally occurring twice daily, and described as a dull ache which usually lasted several hours. The symptoms had been present for one year. The patient had lost twenty pounds during this period. There was no apparent relationship to meals and the time of occurrence was inconsistant. At no time was there flatulence, nausea or vomiting. Defecation occurred with regularity. Upon questioning the patient admitted that he had experienced business difficulties during the past year which had caused him much concern and consequently he had imbibed more freely of alcohol and other stimulants.

Two other physicians made a diagnosis of gall-bladder disease and advised cholecystograms and both stated that removal of the gall bladder would probably be necessary. Neither advised any form of treatment.

Physical examination, August 2, 1935, showed a short man of German extraction, of medium build, dark hair, dark skin and pendulous abdomen.

The head was negative, with the exception of the eyes, which had a yellowish-red tinge.

The mouth and throat were negative; no caries or infection were present.

The neck was negative with the exception of a thyroidectomy scar.

The chest was negative; the lungs and heart were normal. His blood pressure was 140/88.

The abdomen was pendulous, with no point of tenderness, mass or organ palpable, and no muscle spasm or other sign of pathology elicited.

The extremities were negative.

The clinical impression was that of cholecystitis, due to the history, the age of the patient and his general appearance.

Report of X-ray examination. Preliminary view of the gall-bladder region shows that the inferior edge of the liver is slightly above and parallel to the course of the last rib. No calcareous shadows are seen. Serial examination after single and double dose of keraphen administered orally shows no shadow which can be definitely identified as the gall bladder. This finding in the absence of jaundice indicates cystic duct obstruction with or without gallstones.

The icteric index was 4.2.

Although the *x*-ray examination revealed more evidence of gall-bladder disease, treatment was begun under the assumption that the condition was one of gastroenteritis as a result of apprehensiveness and irritants probably attended by hyperacidity, with subsequent irritation or inflammation of the gall bladder.

A diet excluding fried foods, fats, condiments, tea, coffee, alcohol, red meat and raw fruits, and including fresh vegetables, cooked fruits, chicken, lamb and fish, clear soups, bread and milk was advised. In addition medicine was prescribed for sedation, reduction of acidity, removal of toxemia and soothing of intestinal musoca. These medicines were elixir luminal, teaspoonsful 4 i.d., alcaroid one level teaspoonful t.i.d. one-half hour after meal, Sal hepatica, two heaping teaspoonfuls in a glass of water before breakfast once weekly, two tablespoonsful of mineral oil each evening.

Course. The occurrence of pain became less frequent at the end of three weeks and the intervals between attacks longer. At the end of six weeks, the pain had disappeared and did not recur. The lost weight was regained within three months. The patient continued the diet and the medicaments with the exception of the luminal for approximately three months. He has since that time maintained a balanced diet and moderate drinking habits.

When last questioned fourteen months later, there had been no recurrence of symptoms.

CONCLUSIONS

1. The differentiation of enteric and cholecystic spasm is difficult only when the symptoms are located in the right upper quadrant of the abdomen, and are mild in intensity.

2. The diagnosis is accomplished by a determination of etiology.

3. The method suggested is a tabulation of possible causes followed by systematic elimination.

4. The most frequent causes of disturbance in this region are gastric hyperacidity, cholecystitis and peptic ulcer.

A CASE OF TRIGEMINAL NEURALGIA WITH OSTEITIS OF THE WALL OF THE INFRAORBITAL CANAL*

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THE gradual advance in the knowledge of the pathology of the nose, throat, nasal sinuses and teeth has explained the cause of many pains in the face. *Tic douloureux* still remains unsolved (Best and Taylor).[1] The following case is reported because it deals with pathological changes in the bone which are not easily recognized but which appear to have been the cause of the pain in this case and when better understood may be found to be important in the ultimate solution of this affliction.

As Osler[2] states, *tic douloureux* must not be confused with the many minor neuralgias of the 5th cranial nerve, many of which are known to be associated with inflammation in the nose, teeth, nasal sinuses and the pressure of tumors. The typical *tic douloureux*, neuralgia quinta major (Head),[3] trigeminal neuralgia is something different. It is a distinct disease which starts generally in middle life. At the beginning it may have the symptoms characteristic of a simple neuralgia. Later the typical pain develops—severe, having sudden onsets, violent and paroxysmal in character. The disease begins generally in one division of the nerve but may spread after years to involve all divisions of the nerve on one side of the face. It is rarely ever bilateral.

The general characters of the pain are different from those seen in pain due to pressure on the nerve, inflammation involving the ends of the nerves, and those due to inflammation of the ganglia, such as one encounters in herpes zoster. The paroxysms are initiated generally by irritating some point or points on the face along the course of the nerve or certain more distant area on or within the body ("trigger points"). It seems to be due to some disturbance of the passage of a sensation along the nerve fibre rather than to pressure or inflammation in the nerve or the ganglion; or to some systemic change, such as changes in blood pressure, etc.

In this connection it is to be noted that strychnine (Dana) has been known to give relief and free purgation (Esmarch), especially with saline cathartice, has been found efficacious.[3]

It has thus seemed evident that in the eventual solution of *tic douloureux* something different and peculiar will be found to account for the pain in this condition.

In further confirmation of these deductions it is to be noted that no pathological lesion has been found to account for this affliction.[1] Many have believed that the lesion may be in the Gasserian ganglion but no lesion has been found in many of the ganglia removed from these patients; and when lesions have been found (scleroses, nerve degenerations, etc.) these lesions are not different from similar lesions found in other patients who have no pain.[1] No lesions have been found in the nerves in most cases. These facts had led Head to believe that the lesion must be peripheral. It must be a lesion located outside the nerve, having certain peculiarities which make it easily overlooked.

The treatment of this disease has become largely symptomatic, therefore, from necessity; injection of the nerve or ganglia with alcohol or other substances or the removal of the Gasserian ganglion. These methods cause a loss of sensation in the face which may be permanent or temporary

*Read at a Meeting of the Staff of St. Luke's Hospital, Altadena, Calif., April 15, 1937.

depending on the completeness of the destruction of the ganglion cells.

In the case to be described I attempted at the request of the patient to ascertain a cause for her various symptoms. She was suffering not only from the pain in her cheek but also from constipation and pelvic distress. She did not wish to suffer from a loss of sensation in her face and she wanted relief from her other ailments.

The patient, a matron, age 47, had light hair and blue eyes. She was born and reared in Wisconsin but had lived in California for a good many years. She had been fairly healthy most of her life. Her first attacks of pain had begun about eight years previous to her admission. They were slight at first but soon developed into the severe paroxysmal type of *tic douloureux*. The pain began always in the right cheek and radiated up over the right lower forehead. The spasms of pain came often apparently without warning but generally after irritation of right lip or gums ("trigger points"). A slight draft of air, touching the lips or gums with her hand, eating or anything causing tickling of the lips or gums was often ample to bring on an attack.

She had consulted many physicians and at one time had the middle division of the right trigeminal nerve injected with alcohol. She had relief for only three months after this injection. Immediately after the injection she suffered for several days with "swelling, and soreness below the right eye."

When she came to the office she was worn and haggard and fearful always of a severe attack; and she generally had an attack if I examined her nose or mouth.

She had had all her upper teeth removed at the age of 16 years. She said that they were "soft and crumbling." After the beginning of the present illness she had had the remaining teeth removed from her lower jaw. She had well fitting plates. Her tongue was slightly coated. Tonsils were atrophic and not congested. Her neck had a normal circumference. There were no palpable lymph glands in her neck. Her heart and lungs showed no abnormalities to percussion or ausculation. Her abdomen was negative except for gas pockets in the colon and a short midline scar below the umbilicus. This operation was performed before her children were born. She had married at the age of 24. Her husband was healthy. She had two healthy boys, one in his early twenties, another in High School. No other pregnancies.

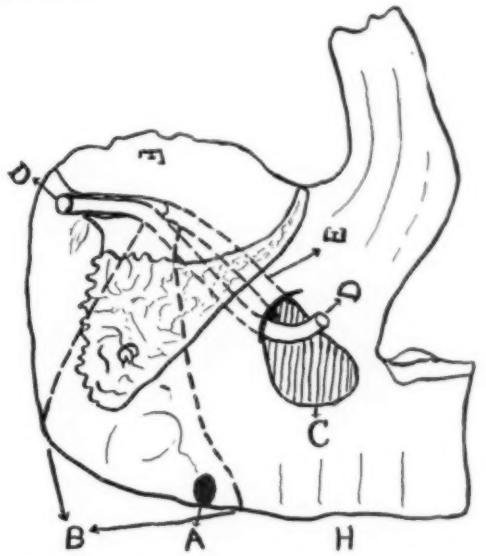

Fig. 1. Anterior surface of the right maxillary bone (H). The dotted lines (B) outline the area of soft bone removed from the lower edge of the jaw to the floor of the infra-orbital canal. A marks the site of the oxydized metal removed from the jaw. C outlined the opening made into the right antrum. D is the maxillary nerve. E shows the position of the infra-orbital canal. The nerve was removed from this canal as noted in the figure. F is the face of the orbit and G is the zygomatic process.

She had suffered for a good many years from spastic constipation and a general moderate prolapse of her pelvic organs.

Her appetite was good. Her knee kicks were normal. Her eyes reacted normally to light and accommodation. Her Blood Wassermann and Kahn reactions were negative. Her temperature was normal at times and at other times it was subnormal.

Her blood pressure was 170/90 and she suffered also from a slight secondary anaemia, a leucopenia, a relatively high lymphocyte count and a strongly acid urine. Hemoglobin, 82 per cent (Dare); R. B. C. 4,360,000; color index 0.9 per cent, W. B. C. 5050 (3 hours after eating); small lymphocytes 44 per cent; neutrophyle polymorphonuclear leucocytes 54 per cent; large lymphocytes 2 per cent.

All of her sinuses appeared normal in the well made *x*-ray plates and when they were transilluminated. She had had frequent examinations of her nose and sinuses. No disease

had ever been found. She had no nasal discharge. The mucous membrane of her nose showed nothing abnormal.

I had *x*-ray films made of her gums. In the upper right molar region there was a small opaque body (Fig. 1, A) in the bone near its lower margin. It was too opaque for a root fragment and not sufficiently opaque for metal. The bone about it had a normal appearing architecture and density. At any rate I decided to explore this region, because frequently of late I had failed to find any evidence of diseased bone in the upper jaw in patients showing the blood count noted above, while at operation the whole area was found to have softened and histological studies showed the bone to be dead.

The foreign body was found to be a piece of oxydized metal. A large area of very soft bone was curetted from this region. This area of soft bone extended from just in front of the foreign body to the rear edge of the jaw and up behind the antrum. (Fig. 1, B).

After this operation the attacks of pain were as severe and frequent as before.

The question then arose, may not this soft bone have extended farther into the thin layer of bone behind the antrum even to the floor of the infraorbital canal. The pain was evidently limited to the middle division of the fifth nerve. This nerve passes through the infraorbital canal just above the antrum. *Tic douloureux* is peculiar to the fifth nerve. The fifth nerve is singular in that each of its branches pass through bony canals. The failure to have found any definite lesion in the nerve in many of these cases might lead one to believe that the lesion might be in the bone or other tissues surrounding the nerve. Several previous authors had noted temporary relief of pain in apparently similar cases after the removal of teeth and operations on the nose. Sluder[4] reports two cases free from pain for three and four years respectively after operations on the sphenoidal sinuses. Jobson[5,6] notes definite remission of the disease after treatment of the middle turbinate, ethmoid and frontal sinuses. How the disease is transmitted to the nerve from these regions and why the disease recurs has remained unsolved. It is possible that the direct cause may be dead bone resulting from disturbances of circulation caused by the above lesions.

The failure to have found this dead bone seems to be due to the fact that *x*-ray films of this region do not necessarily reveal it. The softened bone in this case showed a normal architecture in the *x*-ray films. A careful study of 478 cases of dead teeth associated often with dead bone in the jaw made recently in an investigation of the underlying causes of cancer of the skin and skin appendages (lips, breast, cervix, etc.)[7] has shown an absence of positive *x*-ray evidence of dead bone in 73 per cent of the cases where it was demonstrated when the teeth were removed.

Dead teeth and dead bone in the jaws cause systemic symptoms which seem to be more or less characteristic. These symptoms are an acidosis, a leucopenia, high lymphocyte count, a secondary anemia and a high diastolic blood pressure. The systolic blood pressure may be high or low. The heart rate is also frequently changed. It may be rapid in some and slow in others. Neuritis in any part of the body and skin lesions are often present.

There also seems to be evidence which indicates that dead bone gives symptoms different from those when dead teeth are alone present. The most constant of these symptoms are acidosis, a spastic colitis, often associated with pyelitis and pelvic disturbances. At least the disappearance of these particular symptoms have been most helpful in determining when all the dead bone is removed in a given case. The failure for the *x*-ray films to reveal the lesion in so many cases has made it necessary to depend on other diagnostic means for guidance.

The pathological changes noted in these areas of dead bone which are so frequently associated with pyorrhea, dead teeth and root fragments are not those peculiar to osteomyelitis. The picture is that of a bone necrosis, a mummification. The area is dead but maintains its normal architecture as far as the *x*-ray pictures reveal it. It resembles the dead tooth in this regard. The tooth may show its normal architecture years after its circulation is destroyed and the cells are dead within it.

While in a certain number of cases of diseased bone of the upper jaw, especially after fractures, one sees the characteristic picture of an osteomyelitis—fever, more or less continuous pain, exudation, infiltration with polymorphonuclear cells, a high white blood count with the polymorphonuclear neutrophile leucocytes as high as 80 to 90 per cent—in the great majority of cases this is not true. The lesion is as I described it; a bone necrosis, unassoci-

ated with any noticeable exudation, swelling, and often showing no infiltration of blood cells, except perhaps a few areas containing a few lymphocytes. Such areas of infiltration are often absent. This lesion probably always forms slowly. Only after several years does it involve any very large area of bone. It is known in the literature and is designated as *osteitis*.

This latter type of pathology was present in this case; and it seemed most likely if it extended to the infraorbital canal it would not cause pressure symptoms. On the other hand such a dead area must liberate toxic products which in turn might affect the nerve impulses passing along the nerve fibre and cause the pain.

The fact that such an area of dead bone maintains its normal architecture and cannot always be demonstrated in *x*-ray pictures of this region might easily explain why it had not been demonstrated before in carefully studied cases of *tic douloureux*. Such a lesion must be found most frequently by accident.

In this case I had found it by accident when I had decided to find out the nature of the foreign body in the upper jaw. It had extended up in the bone behind the antrum in the direction of the infraorbital canal.

On account of these facts and deductions, the severity of the pain in this case, and the failure to have given any relief by the first operation, it seemed important to operate again; to explore the region about the infra-orbital canal in order to be certain that the pain was not due to an extension of the lesion in the bone to involve the wall of this canal.

Operation: An incision was made in the mucous membrane where it reflects from the lip to the gum of the right upper jaw. This incision was deep and included the periosteum below and up to the infra-orbital foramen. A window was cut into the antrum (Fig. 1, C). It included the lower margin of the infra-orbital foramen. The mucous membrane lining the antrum was pushed downward. The floor of the infra-orbital canal (Fig. 1, E) was removed with a small chisel. At the rear end of the canal the chisel came into contact with soft bone (Fig. 1, B). This soft bone was then curetted out. It was continuous with the opening made by removing the soft bone at the previous operation. After the operation the nerve (Fig. 1, D) dropped down from the canal onto the mucous lining of the antrum. An opening was made into the mucous membrane of the antrum. A small soft rubber tube with numerous perforations was inserted through the window in the bone (C) and out through the opening made in the gum at the previous operation (Fig. 1, B). Hemorrhage was controlled by frequent irrigations with warm normal saline solution. This tube was removed on the fifth day. Irrigations were continued with a syringe for 2 weeks when the wound was practically closed.

The pain in the nerve stopped at once. No part of the nerve was noticeably injured but there was some anesthesia of the face after the operation.

It was necessary to keep the patient in bed for five days. Even when she arose during this time some slight hemorrhage resulted from the exertion. At the end of a week it was possible for her to be up and about and do as she pleased.

The first operation was performed Oct. 5, 1936. The second operation was performed Oct. 27, 1936. The wound had healed Nov. 14, 1936. She returned to the office Dec. 8, 1936. Her blood pressure was 140/80. Her white count was 7800. The polymorphonuclear cells had risen to 72 per cent; the small lymphocytes were 24 per cent; transitional cell, 2 per cent and large lymphocytes, 2 per cent.

She returned to the office again at my request, Jan. 7, 1937. She had gained in weight. Her blood pressure was 130/80. R. B. C. was 4,620,000; H. 85 per cent, W. B. C., 6800; P. 69 per cent; S. L. 27 per cent, Trans. 2 per cent and L. L. 2 per cent.

I called her again on Feb. 23, 1937. She refused to come to the office. She said she felt too well. I went to see her. She looked exceedingly well. She told me the sensation was returning satisfactorily in her face. She had not obtained a new upper plate. The old one fit well enough. Her only complaint was small visible veins over the area where the dead bone had been removed. Her pelvic condition is not well but it has improved. It probably will not disappear unless aided by operation. A tendency for this lesion to recur after operation is less frequent in my cases, however, where the symptoms of a general intoxication are first removed.

April 10, 1937. The patient has continued to improve and the sensation has returned over a large part of her right cheek.

FURTHER COMMENTS AND CONCLUSIONS

In the above case, the *tic douloureux* disappeared after the dead bone was removed from the wall of the infraorbital canal. This dead bone had formed apparently since her sixteenth year or before.

This lesion in the bone is not one which is associated with noticeable exudation or swelling. There was no evidence to show that it caused pressure on the nerve.

Such a lesion on the other hand must liberate toxic products as it slowly autolyses. These in turn might effect the normal passage of impulses along the nerve fibres.

This dead bone cannot be diagnosed by any known method in a large number of cases. The normal architecture of the bone is most often maintained within it. It can be suspected to exist when foreign bodies, dead teeth or root fragments are present in the jaw.

Pain is often absent in these cases; at least it is not sufficient often to arouse any suspicion of trouble. The more common symptoms are those noted in this patient long before the pain developed; spastic colitis and pelvic distress, changes in blood count, blood pressure and often the heart rate. This relationship between these symptoms in the distant organs and dead bone in the jaws I discovered by accident after following many cases having these symptoms as well as other lesion and dead teeth and dead bone found when the dead teeth were removed.

This dead bone has been found at operations both in the upper and lower jaw and far back in the facial bones about any one of the nasal sinuses. In several cases it has been found to exist where the teeth test vital and show no abnormalities in the *x*-ray films except fillings. When such teeth have been removed the outer shell proximal to the filling was found to be dead.

It thus becomes evident that the lesion described in this case as responsible for the *tic douloureux* could not have been located by any direct means available to the diagnostician. It was discovered by accident. Whether the surgical exploration of the bony canals through which the various branches of the fifth nerve pass will give similar results in other cases of *tic douloureux*, is a problem to be solved by exploratory operation in cases where such seems to be indicated after a most careful study of them.

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ABSENCE OF DORSAL FIXATION OF MESENTERY OF SMALL INTESTINE*

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A LARGE variety of abnormalities of the abdominal portion of the gastrointestinal tract occur during development. The most common are failures of rotation with arrest of the parts and a subsequent intestinal obstruction from bands or volvuli.[1] Congenital atresias and stenoses are commonly found at the site of some embryological event. These errors are essentially located in the midgut except those disturbances in the proctodeum and stomodeum. It is possible to determine in most instances the period of development in which the error occurred, although an explanation of the variation is not possible. This report is concerned with an unusual anomaly in which there was a failure of dorsal fixation of the mesentery after partial rotation had occurred.

CASE REPORT

H. C., a white female, aged 8 years, was first seen on November 11, 1935, with a colicky abdominal pain. The onset began two days previously after eating a raw apple. Soon after the onset the child vomited but was not relieved. A physician diagnosed the condition as an intestinal obstruction. The patient was carried to a hospital and conservative treatment instituted. Normal saline and glucose were given subcutaneously. Enemas were administered with the passage of some gas and liquid feces. The pain was relieved for twenty-four hours. Atropine sulphate given hypodermically would almost stop the pain. On Nov. 11, 1935, the pain became much worse. The child frequently vomited large quantities of brownish-green, foul material. The abdomen was moderately distended.

Past History. At birth a mass developed in the umbilicus after the cord came away which increased in size on coughing and straining. The doctor in attendance strapped the bulging mass on several occasions and after some time it completely disappeared. During the earlier years of the patient's life she was subject to intestinal upsets associated with pain and vomiting. The first attack of severe pain occurred in May, 1933, when symptoms of intestinal obstruction developed, and she was operated upon elsewhere. According to the parents "a twist of the intestine was found and released." In May, 1935, there was a recurrence of the pain and the same doctor again operated and freed some adhesions and removed the appendix. For several months afterward there was freedom from pain.

When first seen the temperature was 99°F., pulse rate 100. The child was very bright and extremely anxious about her condition. There was a marked state of malnutrition. The physical examination was essentially negative except for the abdomen, which was moderately distended. Two short scars were present in the midline just below the umbilicus with an incisional hernia throughout their length. Folds of dilated intestine were seen through the anterior abdominal wall which was extremely thin. Vigorous peristalsis was visualized through the wall and pain accompanied each movement. On examination of the abdomen with a stethoscope a metallic tinkle was heard with each peristaltic movement. No ridigity of the abdominal musculature was noted. The point of maximum tenderness was to the right of the previous scars. No masses were palpable. The skin was extremely dry and dehydrated.

Examination of the blood showed 15,700 leucocytes, 79 per cent of which were polymorphonuclears. The urine showed a trace of albumin but was otherwise negative.

An immediate operation was performed under gas anesthesia. On opening the abdomen a small amount of serosanguinous fluid escaped. The omentum was densely adherent to the abdominal wall underneath the old scars. A

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mass, felt in the lower right quadrant and which could be partially delivered, was found to be a dilated loop of small intestine which

Fig. 1. Demonstrating the small intestine without mesenteric attachment to the posterior abdominal wall. The Meckel's diverticulum is also shown at the site of the twist on the intestine with the production of an obstruction.

was twisted back upon itself for about 6 inches. At the site of the twist a Meckel's diverticulum arose and pointed towards the umbilicus (Fig. 1). A fibrous cord attached the tip of the diverticulum to the umbilicus. The entire small intestine was practically without mesentery with no attachment to the posterior abdominal wall. The Meckel's diverticulum was removed in order to untwist the intestine. It was then found impossible to reverse the intestine due to the extreme edema and acute inflammation with adhesions. The condition of the patient did not permit a primary resection. An ileostomy was considered but it was thought best to attempt a Mikulicz procedure since there was no attachment of the mesentery. The entire twisted and inflamed mass was brought on the outside for about 15 inches (Fig. 2A). The proximal and distal loops were sutured, avoiding the large blood vessels which ran in the serosa of the intestine. The peritoneum was sutured around the two loops of intestine.

The immediate condition was extremely poor. Glucose and saline were given intravenously, followed by a transfusion of 180 c.c. of blood.

There was very little distention postoperatively. At the end of twenty-four hours an opening was made in the proximal loop and a soft rubber catheter was inserted and connected to a suction apparatus. There was only a small amount of drainage obtained through the catheter. Continuous duodenal drainage was instituted with much success.

The progress was satisfactory and on the sixth post-operative day the protruding loops were excised with the cautery. The dilated vessels on the intestine were ligated in the proximal and distal sides of the intestine. This was followed by the passage of much gas and liquid feces from the proximal opening. Continuous suction was used to prevent excoriation of the skin.

The general condition was very good until Dec. 2, 1935. The stomata had contracted to about 2 cm. in diameter. The proximal opening had functioned well until the recurrence of the sudden, colicky abdominal pain. Soon after the onset of the pain, the child vomited. Four hours afterwards the abdomen was moderately distended. The proximal stoma was dark and hemorrhagic in appearance. A soft catheter was inserted and met a resistance about 1½ inches below the opening. In view of these findings it was felt that there was a complete obstruction and an immediate operation should be performed.

An elliptical incision was made around the proximal and distal stoma through the peritoneum. It was found that the proximal loop had twisted circularly several times near the attachment of the intestine to the anterior abdominal wall (Fig. 2B). This was made possible by the failure of the mesentery of the small intestine to become fixed to the posterior abdominal wall. It was, therefore, loosely supported at the duodenojejunal flexure and the abdominal wall. Above the site of the obstruction the gut was enormously dilated with a marked engorgement of the wall. The entire obstructed mass, which consisted of about three feet of ileum, was delivered, resected, and an end-to-end anastomosis done (Fig. 3). An enterostomy tube was inserted above the anastomosis.

The immediate postoperative condition was poor and a blood transfusion was given. Convalescence was stormy for several days but

the child was allowed to leave the hospital three weeks after the last operation.

It has been ten months since the last operation and the patient has done extremely well. She is taking a roughage free diet and has gained twenty pounds in weight.

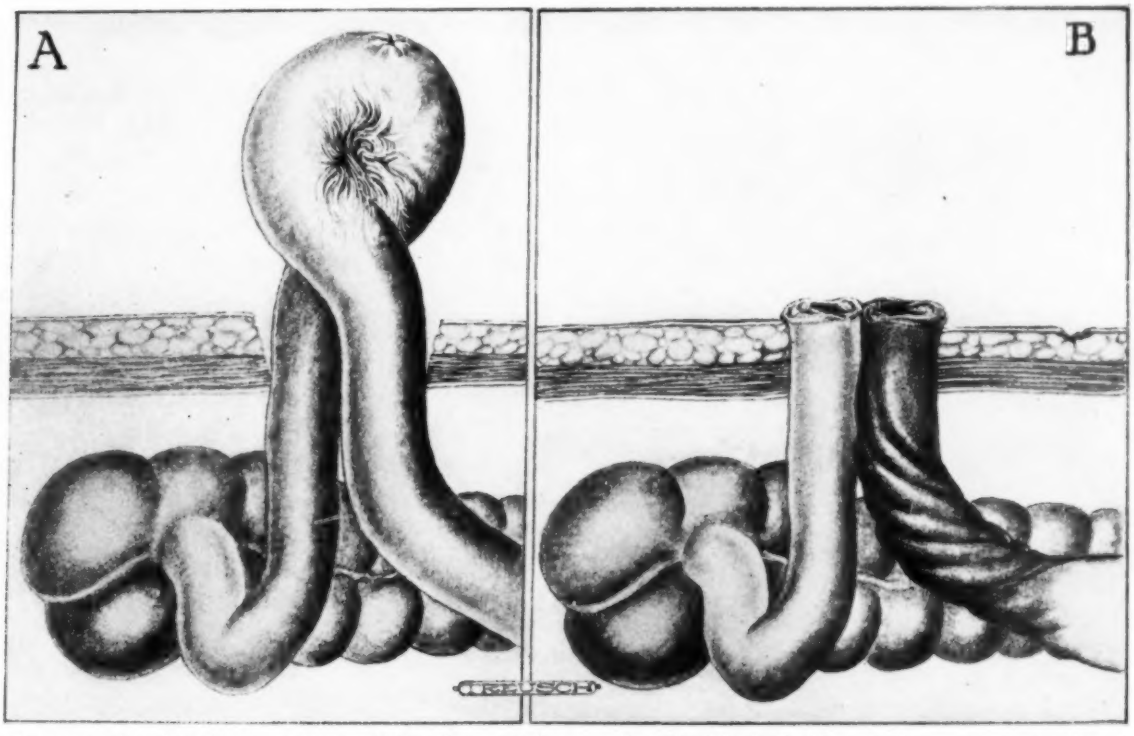

Fig. 2. A, showing the appearance of the obstructed mass after the Meckel's diverticulum was removed and the obstructed portion brought to the outside; B, showing the appearance of the proximal and distal limbs after the second obstruction occurred. A circular twisting of the proximal began at its attachment and extended upward.

EMBRYOLOGY

A detailed review of the series of events in the development of the human gastrointestinal tract will not be made. The essential facts must, however, be presented to appreciate the pathological conditions encountered.

The alimentary canal first appears as an entodermic vesicle, which soon becomes divided into intra-embryonic and extra-embryonic portions, the latter constituting the yolk sac and the former the true future gastrointestinal canal. In the earliest intra-embryonic period the entire tract is represented as a single straight tube. The dorsal fixation of the tract is maintained by a fold of the dorsal primitive mesentery. This is present in the various rotations which follow. There is seen also at this stage a fixation of the anterior portion of the foregut by means of the mesogastrium.

At the fifth week the canal is divided into three divisions; foregut, midgut and hindgut. At this time elongation of the midgut has taken place with the formation of a single loop, with the convexity ventrad. At the apex of the loop the vitello-intestinal duct is attached and projects the coils of intestine into the hollow of the umbilical cord. The vitello-intestinal duct remains present until the fifth week when it looses its connection with the yolk sac and is absorbed. These loops of intestine remain extended until about the tenth week when they are gradually withdrawn into the abdominal cavity. The apex, afferent and efferent limbs furnish that portion of the duodenum below the vaterium segment, the jejunum, ileum and large intestine to the sigmoid. The blood supply of these

portions of the midgut is derived from the superior mesenteric artery which in turn divides into the prearterial and postarterial

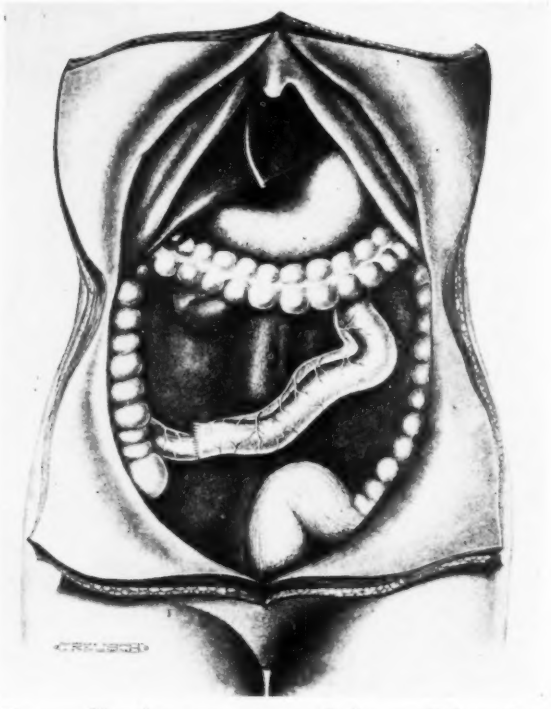

Fig. 3. Showing appearance of the small intestine after resection of five feet of the lower segment. The absence of crenations of the intestines is shown. The small rudimentary mesentery is demonstrated unattached to the posterior abdominal wall.

mesenteric. The descending limb is supplied by the former and the ascending by the latter.

Rotation of these loops are next in importance of development. The first occurs between the fifth and tenth week while the midgut is extended. The second rotation occurs as reduction is taking place and is completed about the eleventh week. The third rotation begins at the eleventh week and is completed at birth or soon afterwards.

The intestine rapidly increases in size so that there is an s-shaped flexure of the descending limb. This portion grows more rapidly while in the umbilical cord than does the remainder of the gut. As the growth of the cecum and ascending portions takes place, a resistance is offered to the return. The superior mesenteric artery extends from the aorta into the umbilical cord and aids in holding this down. After the first rotation the ascending limb passes underneath the superior mesenteric artery and occupies the position within the abdominal cavity behind the vessel. As the terminal ileum passes into this space the end of the superior mesenteric artery is carried with it. The cecum occupies a position anterior to the small intestine and they may pass in any direction. The colon straightens out and carries the cecum upwards and to the right. The large intestine passes across the mass of small intestine. Elongation of the colon increases and the cecum descends to the right lower quadrant. This completes the second stage of rotation which is essentially an anticlockwise rotation about the axis of the superior mesenteric artery of 270 degrees from its early sagittal position.

The third stage is characterized by further descent of the large intestine and fixation of the mesenteries of the small intestine. The duodenojejunal junction is definitely formed. At the twelfth week the mesentery is adhered to the posterior abdominal wall along the line of the superior mesenteric artery to the right lower quadrant. With this fixation of the intestine the length is rapidly increased and consequently the fixation points are relatively shorter. This is made possible by a fluting, or crenation, of the small intestine. Small segments of the bowel are grouped about a common basic attachment to the abdominal wall. The importance of this stage rests in the fact that stabilization has taken place through a secondary attachment along the root of the mesentery.

DISCUSSION

Mesenteric defects are thought to be either traumatic in origin or the result of some failure in development. Edwards,[2] Waugh,[3] Cutler,[4] Judd,[5] and others[6–9] reported instances of small apertures occurring in the mesentery. Loops of intestine and omentum are caught in these defects and thereby produce various degrees of

obstruction and strangulation. Elongation of the mesentery is a frequent accompaniment of these conditions. They may be directly related to injuries of the abdominal wall with disturbances of the blood supply of the mesentery, or a direct rupture of the mesentery itself. Closely related to these conditions must be mentioned disturbances of the fossa with production of elongated folds of peritoneum with the formation of internal hernia.

Since these defects occurred early in fetal life, it is interesting to attempt some speculation as to the time of the occurrence. Not infrequently these abnormalities can be demonstrated as the normal in the intestines of the lower vertebrates. The nearest approach to the case under study is seen in the amphibia and the reptiles, particularly the bull frog (rana Catesbiana) and the mud puppy (necturus maculatus). In these animals there is considerable difference both in the coils of intestine and the types and positions of the mesentery.

It is evident from the numerous changes in size and position of the midgut that widespread deformities might be encountered when arrest of development occurs.[10] The attention is centered around the changes in the third stage in this case. The development progressed naturally up to the eleventh week and the general positions of the viscera were normally assumed. The duodenojejunal junction apparently had a definitely fixed point but the remainder of the small intestine was mobilized. The failure of the mesentery to attach itself to the posterior parietal peritoneum occurred after the eleventh week. The persistence of Meckel's diverticulum demonstrates the occurrence of multiple deformities.

The remainder of the intestine was fixed by the mesenteric and parietal peritoneal folds. The arterial blood supply was maintained by the primitive superior mesentery which passes as expected, through the rudimentary mesentery. Numerous intestinal branches were given off and encircled the intestine. There was an absence of the arterial arcades in the mesentery, since it remained as a very small band.

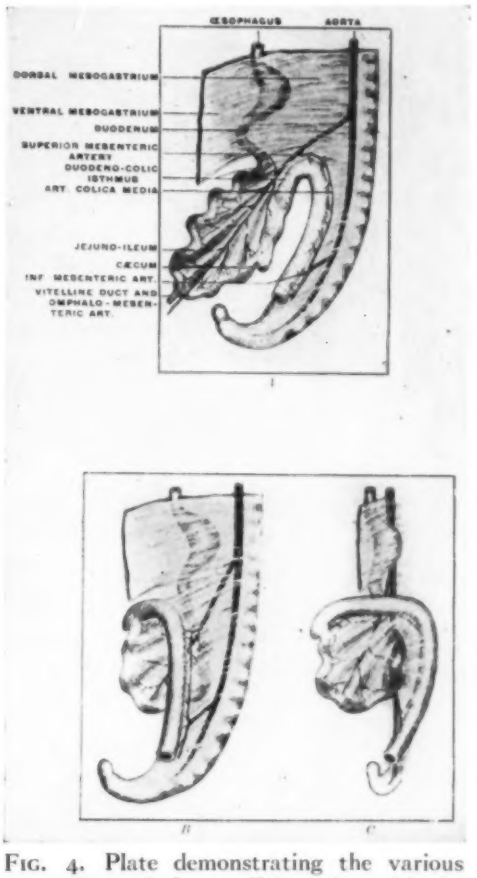

Fig. 4. Plate demonstrating the various rotations of the small intestine with the positions of the mesenteries. (Huntington, G. S. The Anatomy of the Human Peritoneum and Abdominal Cavity, 1903. Lea Bros.)

Mesenteric deformities are frequently associated with abnormal positions due to arrested or impartial rotations. These result in imperfect or incomplete fixation of a segment or an entire area of gut. Dott[11] reports a case in which there was a failure of the dorsal fixation and also an incomplete rotation of the ascending colon. The cecum was situated in the upper and middle part of the abdomen.

The pathogenesis for the intestinal anomalies is extremely varied but as yet no satisfactory explanation has been given.[12,13] Intrauterine trauma and infections are considered by many to be significant. It is assumed that no attachment had ever

existed, although the mesenteries in their formation may be reabsorbed. As has been mentioned, these anomalies are frequently compared to the normal development in the lower vertebrates,[14] none of which exhibit similar findings to those under discussion. The differences for the most part are in the rotations. The midgut of the snapping turtle (chelydra serpentina) is suspended as free coils of intestine with no attachment of the mesentery of the small intestine. The large intestine remains as a continuous tube without rotations having occurred. Since many reptiles, and the aves, demonstrate this difference, it is logical to assume that the defect occurred after rotation had taken place rather than during or before.

It is noteworthy that the patient lived for six years before symptoms of intestinal obstruction developed. Congenital anomalies of the gastrointestinal tract present an array of early symptoms, the more common of which are pain, nausea, vomiting, and vague intestinal upsets. The outstanding findings are those of varying degrees of intestinal obstruction. Mesenteric defects, particularly those of elongation, produce an obstruction by formation of volvuli or strangulation.

The first knowledge of a defect should have been suspected immediately after birth when there developed the so-called "blister" in the umbilicus. From birth to the first operation in 1934 intestinal upsets were common. These findings were for a short duration and never severe and were not considered significant until the first acute obstruction occurred. It is remarkable that relief was given from this obstruction by simply untwisting the volvulus. Relief, however, was temporary since three recurrences were experienced within eighteen months. From this fact it was obvious that something more radical had to be done to relieve the patient.

At the time the patient was first seen, which was during the third attack, the signs of acute obstruction were evident. The absence of marked distention gave the impression of a partial blocking. Temporary relief from pain was obtained by the administration of atropine sulphate, which delayed the operation.

As soon as the type of anomaly was determined, an attempt at releasing the volvulus, after excision of Meckel's diverticulum, was done. Due to the acute inflammation in the wall of the gut, this was impossible, as tearing of the serosa occurred. A primary resection of the involved area was not practical since the mortality rate is 50 per cent. The entire mass was exteriorized with the subsequent establishment of an external fistula. The plan was to follow this by a later secondary anastomosis. However, this arrangement was interrupted by another acute obstruction from a circular twisting of the proximal end of the intestine. This complication was not anticipated but might have been prevented by bringing out sufficient intestine to lessen the mobility of the gut.

The secondary operation was performed under adverse circumstances since complete obstruction was present. Sufficient intestine was excised, before anastomosing the ends, to lessen the likelihood of a volvulus recurring. The small intestine was suspended in such a manner as to lessen its mobility from the duodenojejunal junction to the ileocecal valve. No attempt at fixation of the mesentery to the dorsal body wall was done, due to the poor condition of the patient. This might have been of some value in the future, if the intestines become stretched and assume a more mobile position. In that event, nothing will prevent a volvulus from recurring.

SUMMARY

1. A case of absence of dorsal fixation of the mesentery of the small intestine is reported with recovery.

2. The malformation occurred after complete rotation of the intestine and was followed by a failure of the mesentery to attach itself secondarily to the dorsal body wall.

3. A review of embryological events occurring in the rotations, fixation, and development of the midgut is presented.

4. Unusual complication was encountered during the course of treatment. Longitudinal twisting of the gut occurred with complete obstruction. This was followed by resection and anastomosis.

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Beef broth is that part of the cow which she could not get rid of before she died.

A flustered doctor is the most useless and despicable of men. Read Osler. His doctrine of Aequanimitas should be your first and last lesson.

MUCOCELE WITH PERITONEAL TRANSPLANTATION IN ADENOCARCINOMA OF THE APPENDIX

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COMBINATION of carcinoma of the appendix with mucocele and perforation of the latter leading to peritoneal cancerous mucoid transplants is of great rarity. These associated lesions introduce a number of observations and problems which the accompanying case report gives an opportunity to consider briefly. References to carcinoma of the appendix were rare before the turn of the century, but since that time quite a mass of literature has accumulated concerning this comparatively infrequent lesion. It is not our purpose to attempt a complete review of the literature in this report, as our chief interest centres in certain other associated lesions. It will suffice here to refer only to the more important points in this direction.

All authorities agree that two types of primary carcinoma may occur in the appendix: namely, carcinoids and adenocarcinoma. They also agree that carcinoids of the appendix are in the majority stationary growths with but potential malignant qualities, whereas the adenocarcinomas appear and behave as adenocarcinomas arising elsewhere in the intestinal tract. Hobart and Nesselrod[1] report that the former type constitute 90 per cent of the cases, while the latter make up the remaining 10 per cent. In our experience the ratio is very much higher. It is to this rare type of lesion that we wish to confine our attention.

The average age period for the onset of adenocarcinoma is given as between forty and sixty years by Ewing,[2] Montgomery and Johnson[3] and Leonardo.[4] However, Thomas[5] reported a typical case in a boy 14 years of age, the youngest on record. Regarding the sex incidence, Selinger[6] reports 82.4 per cent and quotes figures of McWilliams as 57 per cent and Boyer as 60 to 70 per cent occurring in women. This greater frequency in women might be due to the fact that a larger number of appendices are removed routinely in the course of laparotomy than in male patients.

Van Alstine[7] cites the following etiological theories: (1) embryonal rests within the appendix; (2) infection, the appendix being a vestigal organ is very susceptible to infection; and (3) nutritional, due to the relatively poor blood supply. We might add that chronic irritation, whether mechanical, inflammatory or neoplastic, is apt to set up malignant changes. However, as in carcinoma elsewhere, the exact cause is not known.

Most writers agree that the majority of adenocarcinomas arise near the proximal end of the appendix. They usually appear as rounded yellowish or whitish masses arising from the mucosa or submucosa. The lesions are usually small and may easily be missed unless careful examinations are made. The microscopic picture is similar to that of alveolar adenocarcinoma arising elsewhere in the intestinal tract. There are glandular structures lined by immature columnar and goblet epithelium with hyperchromatic nuclei of varying size showing mitotic figures. These cells tend to invade the underlying musculature and there is a sharp line of demarcation between the normal and the diseased tissues. Extensive mucoid degeneration may take place. Other types may resemble basal cell carcinoma according to Ewing.[2] Macewen[8] and Behrend and Winston[9] have reported very early cases

without involvement of the muscularis. Metastases are apt to occur in adenocarcinomatous lesions. Horning[10] cites a case of metastasis to the ovaries and states that the spread may be either by implantation or from a retrograde lymphatic drainage. His case, however, was one of carcinoid. Whipham[11] reports a case with involvement of the base of the appendix associated with marked ascites, generalized abdominal carcinomatosis and involvement of both ovaries. He states it was a spheroidal cell carcinoma, but in view of present knowledge, it was more probably a form of adenocarcinoma. It was stated by several authors that adenocarcinoma might cause a spontaneous rupture of the appendix. After removal it is apt to recur.

The symptoms are not pathognomonic. They are generally those of a mild appendicitis but may simulate a partial intestinal obstruction. Diagnosis is almost invariably made on the operating or autopsy table.

Mucoceles of the appendix are described by Boyd[12] as cystic conditions of the appendix due to obliteration of the proximal end of the lumen. Masson and Hamrick[13] and others state the etiological factors to be inflammation, kinking or adhesions of the organ. Mucous glands are stimulated by irritation, with increased secretion and distention of the lumen. Castle found mucoceles in 0.2 per cent of all appendices at autopsy, Kelly and Hurdon in 0.42 per cent in surgical cases as reported by Masson and Hamrick.[13]

Their contents are a thick tenacious mucoid material free of infective organisms. As the collection of secretion continues the appendix becomes sausage-shaped or globular and may reach tremendous size. The muscular coat may become deficient or absent and the mucosa largely destroyed. As a result of this and the increased tension, diverticula may form and later may rupture. When rupture occurs the contents of the sac are poured into the peritoneal cavity, causing a condition known as *pseudomyxoma peritonei*. Along with the mucoid material varying numbers of mucus-secreting cells are also carried out from the lumen of the appendix. These cells may become implanted on any peritoneal surface and are believed to continue to grow, secrete and cause cyst formation. These cysts may in turn rupture, thereby furthering the spread of the condition. Fraenkel reported the first such case in 1901. He states in a later article[14] that the spread of these cells may also occur through the lymphatics. The peritoneal reaction is usually that of a response to an irritating substance resulting in the formation of adhesions which encyst the fluid. Hentz[15] and Obendorfer[16] suggest that a differentiation to cancer cells may take place.

A similar condition may be found in women resulting from rupture of pseudomucinous cystadenomata of the ovary. This needs but mere mention because the two conditions are fairly easily differentiated.

The symptoms are those of a mild appendicitis or partial intestinal obstruction or there may be an absence of all symptoms. Physical findings may simulate appendiceal abscess. As a rule the diagnosis is made at operation. The prognosis is favourable as the transplanted cells usually die in a short time unless malignant change has occurred.

Topping[17] reports a case of coexistent carcinoma of the appendix and mucocele. His case is one of carcinoid.

A case of massive unilateral cystadenocarcinoma of the ovary coexisting with an appendiceal lesion of almost identical microscopic appearance in a woman, aged fifty-nine years was reported by Harnik.[18] Other organs were not involved. In discussing the case Harnik came to the conclusion that the primary growth was in the ovary rather than in the appendix because of the tremendous size of the ovary, its unilateral involvement and because of the extensive necrosis present. The metastasis occurred through the lymphatics rather than by implantation as evidenced by the absence of involvement of the peritoneal surfaces of other organs.

He also cites a case reported by Amann and Held of a woman of 50 years, with a cystic carcinoma of the appendix and a similar one in the ovary. The appendix and right ovary were removed at operation. The patient was operated upon a second time within a year, when the left ovary, uterus, omentum, intestines and pelvic peritoneum were found to be extensively involved in carcinomatous growth. Held contended his case was one of appendiceal origin but his opinions were contested by Simon, who had made a careful study of the pathological material.

FIG. 1. External surface of the appendix showing the point of spontaneous rupture and the peritoneal implants on the surface of the organ. One half size.

FIG. 2. Cut surface of the appendix showing the obliterated lumen at the base. Note also the mucoid contents of the lumen. Point of perforation is also shown. One half size.

CASE REPORT

Miss E. K., aged 49 years, was admitted to the hospital March 19, 1936, complaining of a sensation of tightness and discomfort in the right lower abdominal quadrant, progressive weakness and shortness of breath. Her family history has no bearing on her present condition. She has always been in good health except for measles, scarlet fever, hay fever and transient attacks of rheumatism. Menstruation began at the age of eleven years, occurred regularly every twenty-eight days and was of four to five days duration, and no dysmenorrhea. A symptomless menopause occurred at the age of 47 years. She has had no bleeding nor leucorrhea since. Her first symptoms began three and one-half months ago with a sensation of abdominal fullness and discomfort. Her abdomen began to swell and several weeks later she developed a dull pain in the right lower quadrant but no nausea or vomiting. There has been progressive weakness and shortness of breath on exertion for the past several weeks but no precordial pain or edema. For years she has been chronically constipated.

Physical examination revealed a well nourished white female of the stated age, colour good, no jaundice, temperature 99, pulse rate 92, respirations 20; erythrocytes 5,000,000, leucocytes 6500 and sedimentation velocity 23 mm. in two hours. The head, neck, thyroid, lungs and heart were normal; her blood pressure was 140/82. No lymph glands were palpable. The breasts were small and atrophic. The abdomen was ovoid, the liver and spleen were not felt but there was an indefinite soft mass extending from the pelvis almost up to the umbilicus. Some deep tenderness was noted in the right lower quadrant but no rigidity. The extremities were normal. Vaginal examination revealed a normal vulva and vagina; the cervix at level of spines, large and clean. In the cul-

de-sac and in both fornices were masses of soft texture, about 6 cm. in diameter. The uterus was in good position, moderately enlarged and

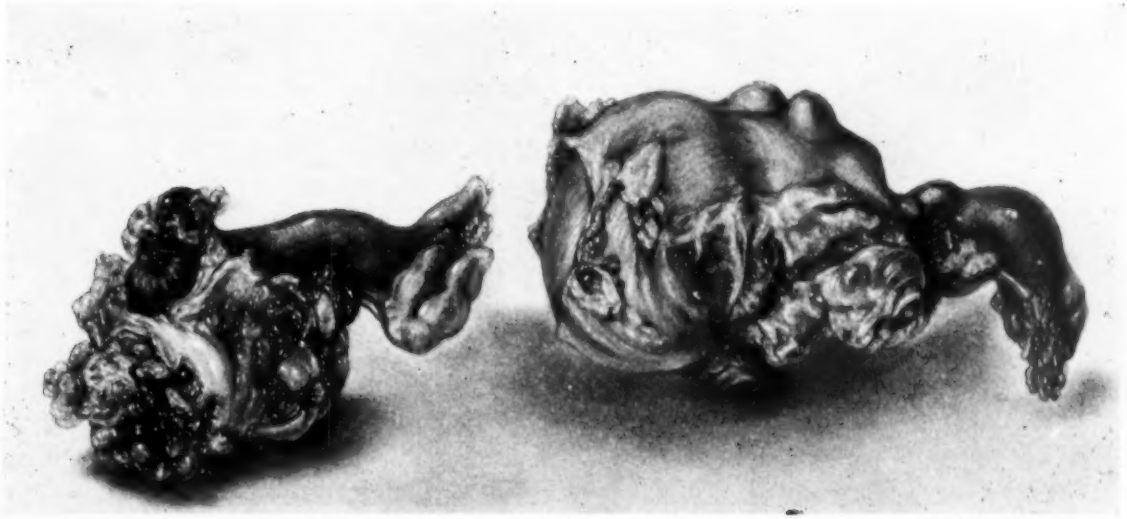

Fig. 3. Uterus, right tube and ovary shown on the right, the left tube and ovary on the left. The extensive peritoneal implants may be seen on the surfaces of the organs. Actual size.

immobile. There was no evidence of inflammatory infiltration. The impression was that of a uterus the size of a six weeks pregnancy, probably fibroid, and laterally the soft masses suggested complicating malignancy.

On March 23, a laparotomy was performed. The pelvic peritoneum in the vesical and rectal pouches was studded with reddish vascular nodules like large grapes, here discrete, there conglomerate. Aggregations were seen on the surface of the sigmoid. The omentum was thickened and filled with nodules. Miliary nodules were felt on the surface of the liver. No free fluid was found. A large massive pyriform swelling was found attached to the cecum by a thin short pedicle, this was ruptured at its outer extremity and extruded mucoid material. The uterus was somewhat enlarged and nodular, was in good position with somewhat limited mobility. Bilateral adnexal masses the size of one's fist were found. The right tube and ovary were adherent to the lateral uterine wall and contained masses of new growth. A large mass lying in the pouch of Douglas was found attached to the left tube. The proximal end of the tube and the ovary were also involved in new-growth formation.

Operation. Supravaginal hysterectomy, bilateral salpingo-oophorectomy, appendecomy and drainage of the peritoneal cavity.

Pathology. Grossly the appendix is sausage-shaped, gray, fluctuant with isolated solid areas and covered by irregular areas of shaggy, firm tissue (Fig. 1). It had been attached to the cecum by a pedicle 2.5 cm. long and 1 cm. in diameter. Its outside length (stump to tip) is 25.5 cm., the inside length 9 cm., and its greatest circumference 17 cm. There is a punched out perforation with everted edges 1.5 cm. in diameter located 4.5 cm. from the tip on the outer and lateral surface. A thin walled spherical bleb, 1.75 cm. in diameter, is seen on the inner and lateral surface 2 cm. from the tip. The cut surface shows a gray fibrous wall 0.25 cm. thick. At the bend on the inner side the capsule is 1.5 cm. thick, gray and firm. The lumen is filled with a grayish gelatinous material with many yellowish patches (Fig. 2). The fimbriated end of the left tube is incorporated in a large, irregular, fungating, grayish-red collagenous mass, 4 by 5 by 6 cm. which is extremely friable. It is attached to the uterus by the isthmic portion of the tube which is 5 cm. long, markedly thickened, semisolid and deep red. The cut surface shows the wall to be firm and gray with large areas of brownish collagenous material surrounding and infiltrating a gray fibrous core. The left ovary is firm, almond shaped, white, 2 by 1.5 by 1 cm. Its cut surface is grayish with dark red mottling. The right tube is 7 cm. long, tortuous, clubbed and fluctuant. Its greatest circumference is 4 cm. The cut surface shows a thin wall and numerous small cystic cavities containing a grayish gelatinous material within the lumen. The right ovary is round, 2.5 cm. in diameter, reddish-gray, friable and shows a cauliflower

growth extending from the superior surface to the cornua of the uterus. The cut surface shows a pale gray surface with yellowish mucoid

Fig. 4. Low power view of appendiceal wall showing marked degenerative changes in the wall and an immature glandular structure invading the musculature.

areas scattered throughout. The uterus is nodular and twice normal size. Many small white nodular projections are noted on the peritoneal surface. The myometrium is thickened and contains several small pea-sized intramural growths which are well circumscribed, whitish and fibrous. There are several large submucous growths of similar character. The endometrium is thin and pale gray. The uterine cavity is distorted (Fig. 3).

Microscopic sections taken at the base of the appendix (Fig. 4) shows an edematous, thick muscle layer. The mucosa is thick, the glands appear normal. Other sections show marked collagenous infiltration of the muscle layers, marked dilatation and congestion of the blood vessels and an extensive inflammatory reaction. The lumen is filled with mucoid material and lined by tall columnar and goblet epithelium showing marked activity. Scattered throughout the wall are many gland-like structures of fairly mature low columnar epithelium, some of which are, however, definitely immature and show active mitosis. There are also scattered nests of small polygonal cells without mitotic figures. The omentum shows dilated and congested vessels and a marked infiltration of lymphocytes and plasma cells. There are scattered throughout many immature gland-like structures lined by rather undifferentiated mucus-secreting epithelial cells showing definite mitotic figures. The left ovary (Fig. 5) contains a rather dense stroma, many corpora albicantia and thick walled blood vessels. Implanted on the surface near the hilus and invading the cortex to a slight extent are areas of glandular structures lined by young columnar and goblet epithelium in a loose collagenous stroma. These cells show definite malignant characteristics. The right ovary is similar to the left only more extensively involved in new tumour growth. The right tubal mucosa is edematous and shows some evidence of a low grade inflammation. The lumen is filled with mucus. Some glandular new-growth formation similar to the above is found in the wall. The left tubal wall and mucosa are entirely destroyed (Fig. 6). Masses of edematous muscle and connective tissue have undergone advanced collagenous degeneration and are infiltrated by many gland-like structures as described. Large amounts of blood clot and fibrin are also seen in the lumen. The uterine wall is thickened and contains circumscribed areas of coarse interlacing bundles of fibromuscular tissue, some of which have undergone hyaline degeneration. Near the outer surface of the fundus the muscle fibres are separated by edema. Numerous atypical glandular growths similar to those described are seen piling up on the surface and invading the wall. The endometrium is thin. There are relatively few glands, some of these are cystic. The stroma is dense.

Pathological Diagnosis. Mucocele of the appendix with adenocarcinomatous degeneration; secondary adenocarcinoma of the uterus, tubes, ovaries and omentum; fibromyoma uteri with hyaline degeneration; and atrophic and cystic endometrium.

The patient developed a phlebitis of the left saphenous vein after operation; otherwise the convalescence was uneventful. She was discharged from the hospital on the twenty-

seventh postoperative day in fairly good condition. She remained in good health for about ten months, when symptoms developed suggesting a partial intestinal obstruction. Her condition became progressively worse and she succumbed rapidly one month later. Permission for an autopsy was not granted.

Fig. 5. Low power view of right ovary showing a glandular growth lined by tall columnar and goblet epithelium on the surface and beginning to invade the capsule.

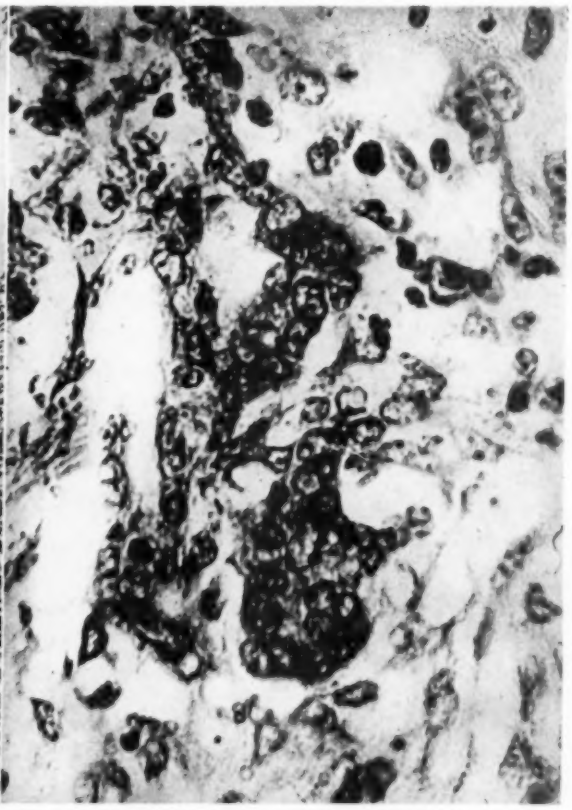

Fig. 6. High power view of left tube. Immature glands lined by young goblet cells showing mitotic figures and hyperchromatic nuclei.

DISCUSSION

This case offers many points for discussion related as it is to a very interesting and by no means settled chapter in pathology.

Marked dilatation of the lumen of the appendix with ballooning out of the organ into a sac is referred to as hydrops or mucocele. It is generally held that such a process is of necessity preceded by an inflammatory obliteration of the lumen at the base, and this would appear to be true in our case since sections showed fibrosis and absence of any opening within the muscular coats in this area. Once this has taken place the sac gradually dilates due to retention of the secretion. It would seem, however, that a sufficiently precise distinction has not been drawn between the two types of changes which may occur following the occlusion. On the one hand we may have a mere accumulation of viscid fluid which dilates the lumen. In this form the mucosa is stretched, flattened, compressed and rendered atrophic. The muscular wall is thinned and of parchment character. Such a picture is aptly designated by the term *hydrops*. On the other hand there may be an accumulation of a large amount of very thick viscid mucus. Examination of the wall in these cases reveals a quite different picture. The normal mucosa has been transformed into a very hyperplastic and even papillary adenomatous type of active secreting surface. The lining cells rise in folds and are

apparently pouring out mucus far in excess of the normal secretion. The wall, moreover, is greatly thickened, fibrous and well vascularized. Such a lesion is quite distinct from the first type and more strictly defined as a *mucocele*. Whether this abnormal hyperplastic and hyperfunctioning type of surface epithelium arises as a result of the obstruction it is impossible to state with certainty, but it does differ distinctly from that encountered in the hydropsical type and indicates a special activity on the part of the surface cells. In another very early case of mucocele, which we had an opportunity to study, this type of epithelium was present before any very marked dilatation of the lumen with mucus had occurred. We therefore are inclined to the view that in this form an alteration of the epithelium in the direction of excessive mucus secretion precedes the dilatation and is of primary importance in the development of the lesion.

When one compares this change in the mucosa with similar hyperplastic alterations elsewhere in the bowel, one is impressed with its striking similarity to the initial proliferative changes leading up to carcinoma of the rectum. It is distinctly an atypical hyperplasia, and, as stated, might be well considered as papillary adenomatous or "precancerous." It is not remarkable therefore that it should frequently go over into true carcinoma, and this is apparently what has happened in our case.

The picture presented by the large ballooned-out sac is not that of a simple adenocarcinoma of the appendix, but rather it suggests that the lesion first developed as a true mucocele which later, by differentiation and emancipation of the cells, became a truly cancerous infiltrative form of growth. Rupture of the wall undoubtedly caused the spread of the growth over the floor of the pelvis, where it has invaded the ovaries, tubes, omentum and the peritoneal surface of the uterus.

Study of histological sections of these areas ruled out to our satisfaction any possibility that the growth in the ovaries might have arisen as a bilateral primary carcinoma of these organs. But it also introduces the still unsolved problem whether cancerous transformation of the discharged epithelial elements from the appendix continue in these transplants. Certain microscopic fields in our case speak in its favour. The growth was confined to the surface with distinct evidence of invasion into the stroma. A similar picture occurred on the surface of the myometrium. Moreover the growth in the appendix could not possibly have resulted as a metastasis from an ovarian carcinoma.

While this case comes within the rather broad and indefinite group of the pseudomyxoma peritonei it should be clearly borne in mind that the reaction in the peritoneum, as revealed by sections, was not merely a response to transplanted mucus and quiescent epithelial cells but rather a true infiltrating cancerous growth, which, while it continued to show a high degree of mucus secretion, also exhibited active proliferation of the epithelial elements.

SUMMARY

An extremely rare case is described of a woman with mucocele of the appendix in which cancerous transformation, rupture and diffuse pelvic transplantations had occurred.

The "precancerous" nature of the transformed mucous membrane of the mucocele and its distinction from that occurring in simple hydrops are pointed out.

We wish to express our thanks to Dr. John Fraser for allowing us to publish this case, and for the illustrations; also to Professor Horst Oertel for his cooperation in the interpretation of the pathological picture.

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Research is not a timeclock-monkeywrench job—it is a state of mind.

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NEW INSTRUMENTS

A MODIFIED CUSHING SILVER CLIP AND CLAMP*

LESTER R. WHITAKER, M.D.

BOSTON, MASSACHUSETTS

THE tying of ligatures for hemostasis is a time-consuming factor in the technique of surgery. And in deep cavities on fragile tissues it is a difficult and uncertain procedure. Neurological surgeons have for years employed an improvement upon ligature-tying in the form of the Cushing silver clip. A single compressed fold of soft wire, however, is inadequate to hold securely the large vessels encountered in general surgery. An effort to overcome this fault has been made previously in the form of a silver staple, placed by a clamp which folds both ends over like a paper stapler.[1] The clamp, however, is more or less clumsy and delicate of adjustment. These difficulties can be overcome by reversion to the Cushing principle of the compressed single fold of wire with certain modifications:

For general surgery the clip must hold the tissue with firm pressure; consequently, a stiff wire must be used.

There must be a mechanism to prevent the clips from slipping off. This is attained by a flange, or hook, on one end of the clip which bites into the tissues. (See insert in figure.) The clip is made from flat wire[2] by a special instrument which shapes and cuts it.

The application of this modified Cushing silver clip requires alteration of the clamp. (See figure.)

It is larger, with greater leverage for bending the stiff silver wire, and longer, for reaching into deep cavities.

In general surgery the effective placing of the clip may require considerable dissection. This cannot be done with the

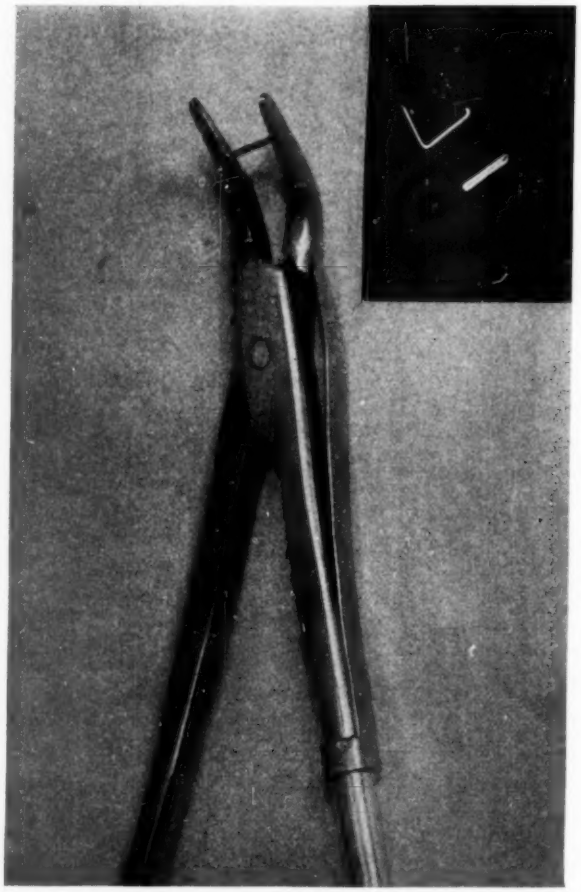

FIG. 1. Silver clip in jaws of clamp. The clip is held in the jaws of the clamp by pressure of the spring against the stiff wire of the clip. One arm of the clip rests flat in the groove on one jaw. The curved end of the clip (see insert) rests in the groove on the other jaw, and slides forward as the clamp is closed. The jaw in which the clip lies flat can be used best for dissection. The clamp is 8 inches long.

The insert shows the clip, actual size, open and closed. Larger or smaller ones can be made. A hook or flange on one end of the clip bites into the tissue to hold firmly. This fits the bevel on the other end to prevent threads of gauze from catching into the ends of the clip after it is closed.

* From the surgical clinic of the Massachusetts Memorial Hospitals, Boston, Massachusetts.

Cushing clamp which holds the clip in it as a "V," the tips of the clip to the tips of the clamp. But it can be done with the clip placed in the clamp as a letter "L," one side of the clip resting flatly in the groove on one jaw of the clamp. (See figure.) The sharp bend in the clip at the other end to form the flange (insert in figure) offers a sliding surface which will travel along in the groove on the other jaw of the clamp as it is closed.

On one side of the clamp there is a spring which makes pressure upon the jaws against the stiff wire of the clip, and thus holds the clip in place in the clamp. It will stay there as the loaded clamp is laid on the table or passed to the surgeon, and even while the loaded clamp is used for dissection, if care is exercised.

Should it be desired to have the loaded clamp even more stable for handling, the ratchets on the handles can be made longer so that the first lock engages while the jaws of the clamp are in position to hold the open clip. In this case, the spring is not necessary. I prefer the spring to the long ratchets, however.

The *advantages*, then, of this modification of the Cushing silver clip and clamp for general surgery are briefly as follows:

The clip is larger, of stiff wire, and has a flange on the end which bites into the tissue and holds firmly. The clamp is longer for use in deep cavities. The spring on the side allows the clip, placed in the jaws of the clamp as the letter "L," to be held there while the jaws are used for preliminary dissection. Many sizes and shapes of both the clip and the clamp can be made for different purposes.

Bethune[3] has devised a special silver clip and applicator for preventing hemorrhage while severing inter-pleural adhesions. The clip has two prongs on each limb to prevent slipping. The applicator, necessarily, for use through narrow openings, is made in the style of an alligator forcep.

Surgical experience affirms that metallic silver is innocuous to tissues. It provokes no inflammatory reaction nor tissue solution as does catgut. Silver clips do not loosen and dissolve. Silver is slightly antiseptic. It does not delay healing like an organic foreign body such as catgut. Infected tissues in experimental animals heal readily about bits of silver. Clips of sufficient size and strength can be made to hold any artery. There is no obvious contra-indication to their general use for hemostasis.

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A NEW SELF-RETAINING RETRACTOR

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WITH so many retractors available, the introduction of another one is only justifiable if it has definite advantages. It must be simple; remain fixed where placed, without the necessity of being tied; must be without any locking nut which may interfere with the operative technique; and must have interchangeable parts, so as to cut down on the instrumentarium. The retractor herewith presented possesses these qualities.

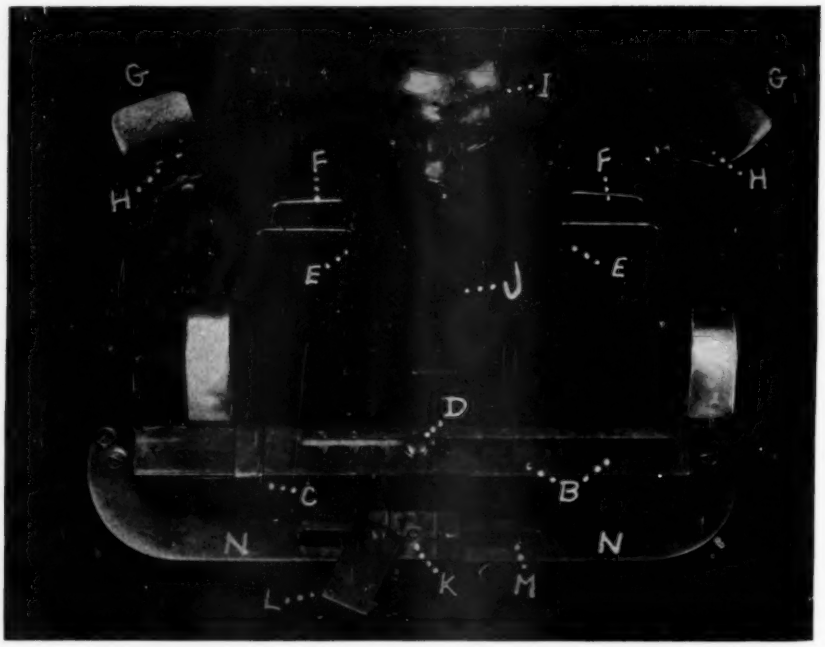

FIG. 1.

Description: There are two main right angled blades (*AA*). The horizontal part of one has a ratchet (*B*); the other has an encircling collar (*C*) and a screw (*D*) to engage the ratchet. The parts are easily locked at any desired point by approximating the distal ends and unlocked by diverging them. Each tip contains two rather sharp prongs (*E*), enabling the retractor, in its simplest form, to be used as a sharp retractor. Near the end of each blade, there is a special oblique slot (*F*) to accommodate the heads of any variety of intra-abdominal or vesical blades (*G*). These latter contain two apertures (*H*) which engage the afore-mentioned prongs of the sharp retractor. All the locking devices are such that the greater the muscular contraction, the firmer the parts become set.

A third blade (*I*) to pull at right angles to the other two, consists of a blade and a perforated handle (*J*). Any one of the perforations may engage the small button (*K*) in a box which is simply but firmly closed by a lid (*L*) not having any projecting handle or nut. The box with its contained blade is laterally movable in a slot (*M*) on a secondary curved bar (*N*) attached to the ends of the ratchet bar.

After years of usage, the described retractor has given absolute satisfaction.

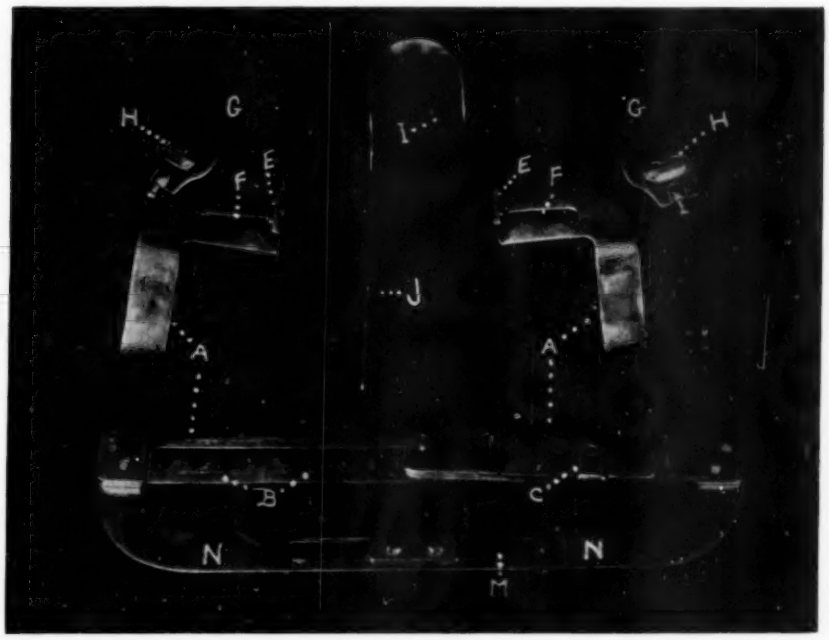

Fig. 2.

Fig. 3.

NEW FRACTURE AND ORTHOPEDIC WRENCH

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CHICAGO, ILLINOIS

FRACTURE and orthopedic wrenches have been in use for a number of years. The original Thomas Wrench was introduced in this country by Dr. Ridlon in 1888, and is modeled after the handle adjustment type of monkey wrench.

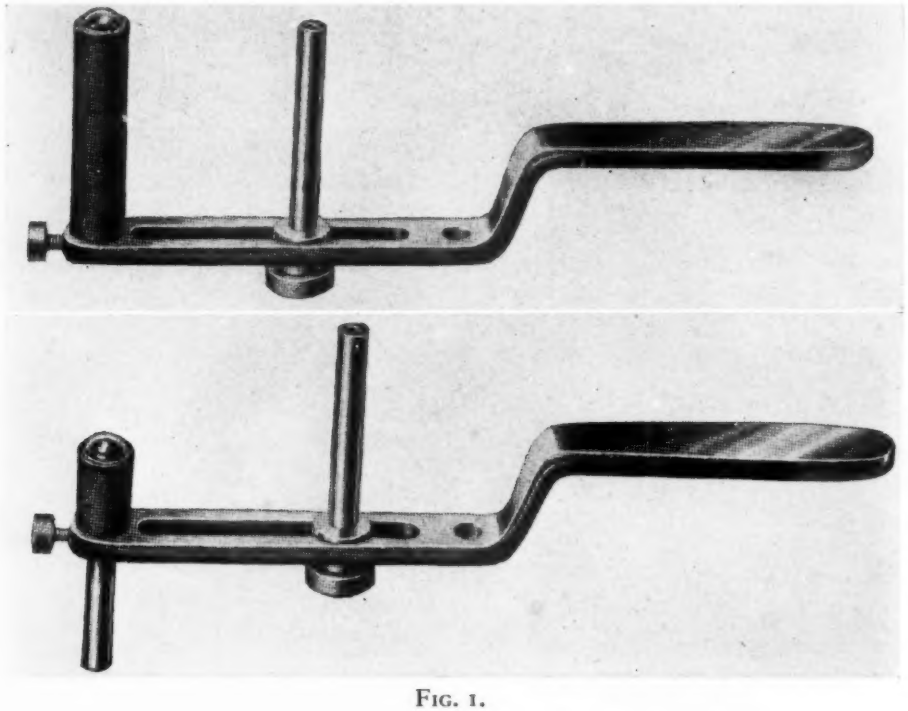

FIG. 1.

This new wrench, due to the adjustable features, can be used with greater ease, and better results over a greater range of cases.

It has a sliding upper jaw which can be easily adjusted for application to one bone. The end of this jaw has a conical knob which keeps the part from slipping during manipulation. Upper jaw has a two piece rubber covered metal sleeve. This permits jaw to roll over skin and consequently decreases the amount of traumatic and abrasive action. It has also been found that a block of adhesive placed on skin where the jaw impinges protects the skin.

The jaw can also be inserted lower down on the bar handle to permit the operator controlled leverage by grasping the handle above and below jaws. There is an off set in the handle in order to give true mechanical leverage. Lower jaw can be quickly adjusted into place and will remain locked without necessarily tightening thumb screw.

This instrument is being used in Colles's and Pott's fractures, neglected fractures that require rebreaking, congenital and acquired club feet, and a variety of cases that require controlled mechanical adjustment.

It has been found indispensable in a certain percentage of fresh Colles's fracture where the distal fragment is short, and in neglected cases where there is callous formation which requires rebreaking and resetting.

A MODIFIED BÖHLER CLAVICULAR BRACE

ARTHUR J. DAVIDSON, M.D., F.A.C.S. AND M. THOMAS HORWITZ, M.D.

PHILADELPHIA, PENNSYLVANIA

THE Böhler clavicular splint has uniformly proven itself a most efficient support in the conservative or post-operative fixation of clavicular fractures and separation of the acromio-clavicular joint. The brace herein described, adheres carefully to its mechanical principles, but eliminates those factors that have made the usual type of splint burdensome and awkward, especially to the discerning patient, in the experience of the authors.

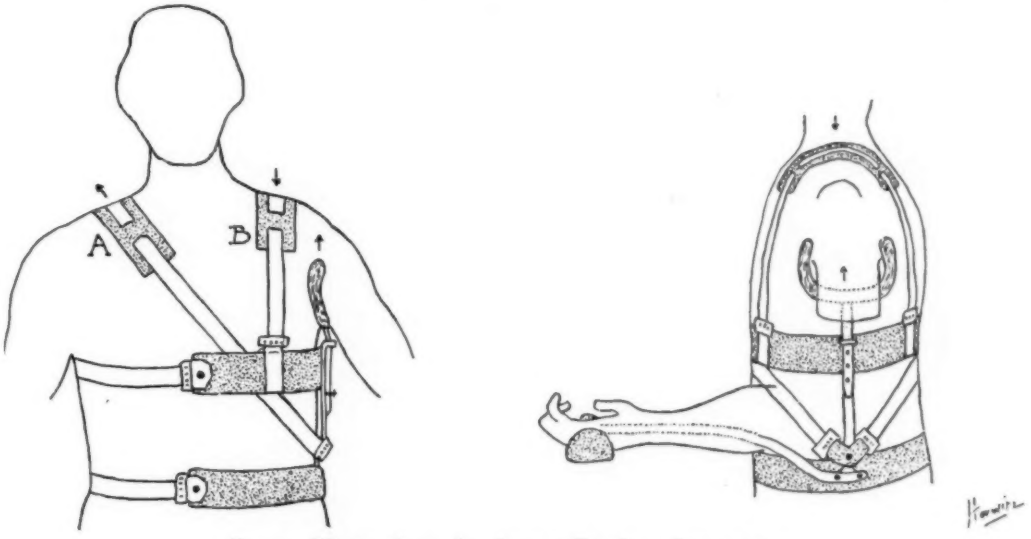

FIG. 1. Illustrations showing application of apparatus.

The adjustable upright with well padded axillary crutch and the forearm rest are made of surgical brace steel *and may be adjusted to either side of the body*. The broad pelvic and chest bands, well padded with felt and leather, pass half-way in front and behind the trunk and are strapped on the opposite side. The suspender-strap *A*, passing over the well shoulder, maintains the upright well into the axilla on the affected side, while the suspender-strap *B* passes over the affected shoulder, depressing the elevated clavicle or medial clavicular segment.

This entire ensemble weighs little in excess of 2 pounds.

We wish to acknowledge the assistance of Mr. John Henry in the construction of the brace.

FIG. 2. Anterior view.

FIG. 3. Lateral view.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

SIR JAMES MACKENZIE, THE COMPLETE PHYSICIAN

BEN WOLEPOR, M.D.

LACHINE, QUEBEC

THE appellation, a great physician, does not imply solely the merit of a man's contribution to Medicine, but a summation of his qualities. The attitude of the man, his philosophy, often determines his contributions to learning. When one regards Sir James, one sees greatness depicted in his countenance; he views vast distances, encompasses the world in a fearless sweep; the uplifted head, signifying defiance, is softened by the brooding tenderness of his eyes, steadfast pools, overhung by the massive brow one often observes in great musicians, men who are attuned to the cadences of the universe. Beethoven, Schubert, Mozart, all possessed these powerful ridges that jut above eyes whose flames Time cannot dim. Youth, it appears, pursues genius to the end. The imaginative faculty of the young does not atrophy in the genius but paces concurrently with the sweep of the years.

A cultured age is one that permits its thinkers, of the heart and mind, unrestricted progress. The world is civilized only when it gives its dreamers freedom. Then Philosophy flowers and Science grows ripe; Art thrusts forth new leaves and a spirit of rich harmony and beauty exudes from sympathetic sources. Liberty is a much disputed word and has lost value but the freedom of initiative that Mackenzie possessed is fast disappearing from the world. He who fought his generation, was the inheritor of an expanding quality that is rapidly being effaced from human consciousness in a desperate attempt to evoke the spirit of the Middle Ages.

MEDICINE, AN ART

Physicians who would make of Medicine a pure science, who would divest from the patient his faculty of judge, of narrating sequence of events and descriptions; who would have man judged on a basis of vials, ampoules, electric currents and shadows, need but regard the pure science of physics where laws are supposedly immutable. But here we find that a new school of thought has turned to the nebular mists of theology in despair, "There is nothing fixed," they protest, "Nothing permanent. There are no laws, only flux; a seething maelstrom of ions, protons and waves. Matter tracked to its ultimate particles still eludes the grasp. There is no cause and no effect"; and with the awe of ancient pagans they walk the sacred grove seeking the Golden Bough, "Physics," they maintain, "is a branch of mysticism."

There is no need to relinquish the harvest of the years. Harrow will replace stick;

reaper, the sickle; but the elements remain and the soil. Man will still contort writhing lips after a brutal race; avert his head when a blow threatens, and cry aloud with pain when a stone forces its irresistible way through a duct. Mackenzie claimed that the Truth is visible. Our vision must be strengthened, our curiousity stimulated. The future of Medicine lay in the hands of the clinician. The laboratory threatened to usurp fields alien to its own great destiny. The study of the sick would ever be a contemplation from the bedside. The laboratory can offer inestimable aid under the aegis of the clinician. He will decide. Disease is not the Devil of the Hebrews that invaded maddened swine. It is not the introduction of new factors alone, but that lack of harmony that besets the mind or flesh, induced by a disproportion, a shifting of values, often a preponderance of inherent factors and at times a diminution of these proponents. There is myxedema, normal combustion and hyperthyroidism; the growth of the embryo and carcinoma; the stages of maturity and arteriosclerosis. Life is a pendulum whose uttermost reaches are birth and death. It is a symphony whose dissonances are disease, and the notes at the disposal of the arbiters of destiny are contained within the human body. The exudate of pneumonia, the infiltration of tuberculosis, the gumma of syphilis, the vasculature of carcinoma, the thickened intima of arteriosclerosis, the narrowed vessels of hypertension, these are but examples of disharmony. The note is flat, the singer off-tune. True that the irritant is essential in many instances, but only in definite circumstances will the ox develop typhoid and the hen, anthrax. The factor of disease is not strange; the miracle lies in that vast city of a million, correlated cells, that function in the harmony we, for want of a better name, call health. The correlation of facts gleaned by scientists now becomes a philosophical task.

Why more stress is laid upon reduction of buffer substances in the blood, or reduced alkalinity, or the electric wave in the heart, than upon the patient's description of how he feels, is hard to understand! The patient sees a doctor because he doesn't feel his usual self, he suffers pain or has lost his appetite, is short of breath or has lost weight. The physician will sift evidence, as presented by the patient, who, like a chronicler, narrates events and sensations as they affect him. The medical judge will appraise the significance of this mass of evidence, give it a name, the diagnosis; and then because of the correlation of experience, reading, type of patient and speed of transpiring occurrences, prophecy; the result is prognosis. It is all very complicated and confused; but so is the distillation of sunlight on canvas and the recording of grief on mouldering pages. Medicine has ever been an Art and whether we admit it or not, partakes perhaps too much of intuition, another name for knowledge which has not seeped through to the surface of consciousness. No one can deny that Science found Medicine a compound of witchcraft and theology, the nucleus of shrewd facts and a wild blundering, and resurrected her. She can however contribute only so much, despite her invaluable gifts; the rest depends on human, changeable factors.

Why do certain cases of rheumatic aortic regurgitation withstand all vicissitudes, whereas others perish in a comparatively short time? The physician here relies upon the dicta of Mackenzie to protect himself from rash assurrances and to safeguard his patient's dwindling resources. The physiological point of view supersedes the pathological. The Wassermann reaction may be positive and yet the patient live to be eighty; syphilis may pursue a malignant course and yet all fluids may be negative; tuberculosis may destroy a patient in a short time, although when first seen the lesion was minimal in extent. Mackenzie was far from minimizing the importance of mechanical devices. He may have overemphasized to win his case, for he had always pled for the unpopular cause and perhaps was too dogmatic, as

in his condemnation of the stethescope. He saw, however, a valuable ally in the patient, who if astutely investigated, according to his own method, would greatly facilitate a proper understanding of disease. This announcement is of the greatest importance. Medicine can be practiced well in isolated districts, in the wilderness. He freed the physician from bondage and the toils of a machine age. He taught him once more to use the unaided senses and divested false gods of their unmerited laurels. For this reason, if no other, he merits immortality. To emphasize forgotten truth is as important as the enunciation of cardinal principles. We rarely regard Mackenzie as a teacher but look upon him primarily as an investigator but one of his most important roles was that of the disseminator of well-established fact which had fallen from grace, due to the inconstancy of medical fashion. The role of historian is one of the numerous guises of this illustrious doctor. It is so much more satisfactorily mystifying to regard the hieroglyphics of the electrocardiogram than to have the patient say, "Doctor, I am short of breath. I get choking attacks which awaken me from sleep. I can't walk as far as I once did. It's getting worse all the time."

Detractors of Mackenzie's theory claim that dyspnea may be renal rather than cardiac. This fact may be easily solved by simple, appropriate methods, available to all doctors. Mackenzie fought long for recognition of his important graphic contributions of the heart beat and yielded a valiant field when he felt that it was unworthy to defend. He forged higher into the heights, beckoning the young and eager to follow him.

A characteristic of Medicine is its constant vacillation; enthusiasm and decline; hard won advantages often reluctantly relinquished and unworthy measures ardently advocated for a brief spell. The characteristics of the progenitors of man appear in this peculiar shifting and instability, eager desire and complete forgetfulness, burning curiosity and then deadening apathy. An essay can be written on the essentially human factors in Medicine, inherent emotions pitted against truth.

MACKENZIE AS PHILOSOPHER

It is difficult to understand Mackenzie's repugnance to signs and his exclusive defense of symptoms. A symptom differs from a sign only in that the patient's subjectiveness is involved.

Science was an irresistable stream, born of the witchcraft of the alchemists. Their spell was binding and all the eloquence of a thousand orators could not undo the inevitable trend of events. The courage of this single minded man compels admiration. Standing abreast in a raging, sweeping torrent that had arisen from cold, crystal heights, that had awaited centuries for the words of liberation and was now coursing madly down yielding hill and severed plain, he commanded the stream to stop, to listen and to obey. But the current was not human. It was a conspiracy of events. It had had its birth in the songs of Provence and the eager gaze of a fifteenth century charlatan, in the prophetic vision of Roger Bacon, and the majesty of Elizabeth who ruled England. It had participated in the agony of Lear and heard him call to Cordelia who had died young, a futile call, as splendid and as weak as Mackenzie's. The river knew that Truth is a phase in Time and all the genius in the universe could not efface a syllable of destined utterance. Men spoke and felt as they did because of necessity. They were clay, kneaded by the sculptor of intransigency and swayed to circumstance as a reed to the vagaries of the wind. It blew where it listed.

He, who knew the rigid course of the reflex arc, ignored the stream of events and the established system of thought that by repetition had become a form of scientific morality. He sought stability in a maelstrom and a clear way in a whirling pool. He threw with a convulsive shudder the back-breaking mass of facts and would

bind knowledge in the golden thread of generalization that he confused with Truth. Although he erred his method reveals a towering intellect and a man of heroic mould.

It is not wholly an accident that man has left the trees and the reaches of a windy cave. He was attracted to the infinite as seed to the light. The acquisition of truth was a corollary of its desire. To will was to possess, and this has evolved man from the golden ape. Within the compass of a skull, heaven lay and the radiant mists of Paradise lifted in a narrow vault. To imagine was to contrive, and to will, perform. Symphonies lay ripening in the quavering notes of a prehistoric Pan, and Raphael, as yet unborn, was premeditated in the monsters that raced across the dim walls of an ancient cave. Dante's Inferno and Milton's Lost Paradise, Keat's odes and the lament of Jeremiah; Burn's lyrics and Macbeth lay aborning in the sleepy eyes of a renascent ape. This spark, this immortal flame, that defied Time and glaciers, flood, pestilence and the corroding forces of Death, forced men to clearly enunciate prophetic utterance. Digitalis, the cardiac irregularities, dyspnea, pain, capacity to work, were shifted and rearranged and a clarifying principle emerged, that of the reflex arc. The name differed, but the song was the same. It was the song of the sons of men who had inherited the earth. The scholasts sang this tune; Francis Bacon expatiated upon it and Emerson believed that it held the nucleus of wisdom.

Laennec partially led physicians away from symptoms to signs and now Mackenzie urged them to retrace their footsteps. He would not pursue the middle way, but blinded by his vision, demanded all or nothing. Tuberculosis simulates in a grave form only too often the benign aspect of a benign bronchitis. A slight cough, sore throat, mild fever if fortunately observed, a not necessarily rapid pulse, yet the roentgenogram reveals marked infraclavicular involvement; abnormal conduct in a man of 40 with apparently no obvious disease, yet the spinal fluid reveals paresis; the exhaustion of an apparently healthy man explained by a blood count that reveals leukemia. How are we to explain the substitution of dyspnea for pain in coronary occlusion? Pain, it appears, is a relative factor, depending on lesion and patient. Symptoms are as fallacious as signs. Mackenzie, like all philosophers, fell victim to a generalization.

Medicine can never be a science because the latter requires laws, and every man is a world unto himself. Tuberculosis affects men psychologically according to their individual bent. Some ignore the fatal ravages of disease whilst others regard benign lesions with alarm. A textbook of medicine is at best a compromise; a truce that Truth exacts of experience.

What can the heart do? Will this heart enable the man to carry on? How estimate his lesion and its progressiveness? The polygraph elicited findings that altered the views of Medicine; revealed new burdens, lightened old ones, outlined the essential and made clear the obscure, gave reassurance to those falsely bereft, disclosed new rhythms, but in spite of its contributions, would not speak for itself. It required skilful interpretation and Mackenzie found it lacking. The mind of the doctor was still assailed by the omnipresent problem, heart failure. The enigma was unsolved. An abnormal rhythm was a load many hearts survived. The machine was discarded and the patient consulted. Was the reaction to effort satisfactory? Was there a diminution in his response? His answer solved problems. This method was to be applied universally. The solution for one organ was the panacea for the body.

How stay the ravages of the years, restore the strength of a failing circular tree? Man was pitting himself against Time. Chronic nephritis and cardiac failure, were only too often the presage of old age and death. The future of Medicine did not lie here. It lay in hygiene, bacteriology, the amazing strides of mechanics, chemotherapy, endocrinology, psychiatry, the

study of cells, their growth and function. The years could not be combated. There was no reversible current, no rejuvenating fountain of youth. The processes that ripened the apple made it rot and the flush of youth was the precursor of the seamed grey cheek, the palsied gait, the failing memory and the inelastic mind. The calm of old age was the premonitory truce life placatingly offered death.

THE DOGMA OF MACKENZIE

Men, usually poets, at a crucial phase in civilization, either political or economical, feel impelled to deliver what they consider a universal panacea. The result of their appeal may mean stoning, excommunication, death or that which they fear more than all else; the death of their hopes, ridicule. Followers, attracted by their leaders' sincerity and their awareness of impending chaos, formulate a scheme whereby emotion may be crystalized. Dogmas are born and various cults. A great poem becomes Buddhism and Apollo would not recognize himself in his acquired garments. The desire of man for permanency, form, obliterates the essential poesy of the original message and later adherents squabble over non-essentials.

THE CLASSIFICATION OF SYMPTOMS

a. The object of a classification.
b. The basis of a classification.
c. The principles of classification of the symptoms of disease.
d. Classification and investigation.
e. The application of classification to investigation.

THE OBJECT OF A CLASSIFICATION

The multiplicity of symptoms has already been a subject of comment. As clinical medicine continues to split into branches, due in a measure to the recognition of new symptoms and new measures for their detection, the mass of symptoms is continually growing. If to this mass there is added the reactions—which are in Nature identical with symptoms obtained in other branches of medicine, as bacteriology, pharmacology and physiology, there results chaos.

If progress is to be made, some concept must be introduced which will render the phenomena easier of comprehension, and which will act as a guide to further research.

THE BASIS OF A CLASSIFICATION

We adopted the proposition that while phenomena in Nature may be infinite in number, the laws governing their production are few. In the production of symptoms and reactions, there were present two factors, namely, living structures and vital processes. It was assumed that the laws might be discovered by a more intimate knowledge of these two factors.

It was found that vital activities of cells are dependent upon the accumulation and discharge of energy; shown that the manifold variations were dependent upon the rate of renewal of energy after its discharge. The rate of renewal varies through influences which increase or decrease it, and which regulate the activity of cells collected together to form an organ.

As it is only in these three ways that vital processes act, all symptoms and reactions can be grouped according to which of these three ways the disturbance arose which produced them, and thus we are able to classify symptoms in the manner given in the following table.

THE PRINCIPLES OF CLASSIFICATION OF THE SYMPTOMS OF DISEASE

The following are the propositions on which a scientific classification of symptoms is based.

1. All forms of vital activity are due to the functioning of living cells.

2. Living cells are never at rest, but either discharging energy or renewing it.

3. Modifications of all activity can only take place by hastening or delaying the renewal of energy.

4. Certain cells exercise a controlling influence over other cells. The functional activity of organs is regulated and controlled by structures other than those which are engaged in discharging the function of the effector organ. These structures with the effector organ constitute the elements of the reflex arc.

Symptoms are due to a disturbance of some element of the reflex arc. Such disturbances result in:

1. An increase in the number of impulses.
2. A decrease in the number of impulses.
3. An interference with the generation or conduction of impulses.

These results give rise to three different kinds of symptoms or reactions.

1. An increased activity of an organ.
2. A decreased activity of an organ.
3. A cessation of activity, or an ill-regulated, or unregulated or purposeless; or disorderly activity of the organ.

A principle thus emerges which guides investigation, namely, the principle of the reflex arc. The application of this principle in investigation has for its object;

1. The detection of the part or element of the reflex arc whose disturbance causes the symptoms.
2. The detection of the nature of the disturbance—that is, whether due to increased activity, or decreased, or interference with control. This leads to the recognition of the seat of disturbance and its nature.

It is readily perceived that we are dealing here with a philosophy of medicine. Only greatness assured of itself would have attempted so hazardous a feat. Greatness and imagination. Whether he was right or wrong is immaterial. The fact remains that a country practitioner attempted to define disease and interpret Medicine in a few brief sentences. This is not of the earth, but neither are the Pleiades. Philosophers are always convinced of the truth of their assertions; lesser mortals are content in merely discussing their views. Mackenzie felt that he was showing Men the way to medical heights; he was in reality retracing the effaced paths of the medievalists. Truth, like freedom, was an abstraction and a fluctuating one at that and resisted all attempts at definition. Best be content to say that a certain event had taken place, describe it as well as possible and offer a suitable explanation. This humble attitude was abhorrent to the man who would describe the phenomena of creation in as brief and authoritative a manner as the author of Genesis. There is, strangely to say, nothing repellent in this view that is antagonistic to all physicians' value. Mackenzie epitomizes in his inarticulate struggles all the desires of mankind, to know the enemy and hence to destroy him. To make waxen images of the oppressor and to impale it with pins; to encompass growth, decay, desire, destruction, birth, death, symbiosis, antagonism, luxuriance and atrophy in a few compelling phrases. The Word had not lost its power and had bewitched him. We can understand this phenomenon when we reflect that he had been a novelist as a youth. Writers are very prone to overemphasize the value of the little marks that fascinate them. Men have been known to forego the delights of awareness for the dubious privilege of transcribing the symbols of thought.

The novelist is essentially a student of broad, sweeping events. He is an observer of change, of Time and her sequels. Man is no longer a breathing biped but the vessel of fulfilment, of distance, alteration and the varied phases of that renewing force we call life. Within a page, a civilization arises and dies. Rome is enclosed in a brief paragraph and the virtues of Aristophanes are reflected in a sentence. There is a desire to enfold all the conflicts of existence in a tide of ink. There must be a beginning and inevitably an end. The Artist would go the Creator one better. He outlines the latter's work for him. "This must be, because I otherwise refuse to see sense in a chaotic existence. If I were God this is the way that I would have fashioned the universe." Edward Fitzgerald and Sir James say the same thing in a different way. There is a reason for the latter's insistence on fluctuation, nor did an insect-eating plant demonstrate this alone. He saw this fact because he was receptive to it. Ecclesiastes also sang of a magic circle. His song rang with futility. The vision of the Greeks had imperilled the strange optimism of the Hebrews. The arc had existed long before scientists had described it; and poets sang of mist, rain, streams and

the replenishing sea in ages past. The reflex arc was no miraculous anodyne nor a Delphic oracle. The chronicler of events had become a visionary and Mackenzie, who described the function of the heart, lapsed into the philosopher. It could not be otherwise. The character of the man compelled him to act as he did.

MACKENZIE'S VITAL PROCESSES

Mackenzie was very fond of the word vital, as though living flesh differed conspiciously from inert protoplasm; as though Death had liberated the vital essence of the Greeks, that like steam, arose from the spouting blood of sacrificial animals. A group of modern biologists seem to have adopted this anthropomorphic conception. It is a manifestation of despair; a sign of failure in the corralling of the essential qualities of life. They will not admit defeat and achieve a doubtful victory by embracing mysticism; insisting that the individual cell possesses that which is equivalent to a brain, an inherent purpose; acting in a specific manner, endeavouring persistently to fulfil the cycle of its destiny and striving to accomplish its predestined architecture. It is a scientific cast of the views of Calvin and the Queen of Navarre. Great biologists timidly approach the sacred arch of teleology and reverently touch its hallowed curve. "There is a soul within the flesh," they maintain, "not alone in the vast city of numberless cells, but in all its participants. They are determined, subconscious thinkers, plotting mutely like deliberate, living automatons, a destiny which they feel, but of which they are dimly unawares. They are enervated ants deprived of locomotion but imbued with its volition, unawares of harmony but drenched in its essence, oblivious to sensation, but yielding to its prompting; deaf musicians who thrill to inaudible symphonies by means of Grace."

The bewildered scientists strive desperately for elucidating terms; spurn accepted, theological terminology, and although they will not admit it, have formed a new cult. Philosophy, that spawned Science, now claims the frog as her own.

The scientist has apparently exhausted the inductive method and finds it as blind a canyon as the deductive. Francis Bacon led men nearer the promised land than Thomas Aquinas, but they still wander in the desert. Recourse must now be had to intuition. There was method in the inspired madness of Spinoza; he laid great stress on the quality of insight. The unconditioned reflexes of the brain were as important as those of the medulla oblongata. Awe, was as intrinsic as breathing, reverence as potential as the rhythmical pace of the heart. Ideas were spun with the rhythmicity of the spider's spinners or the pendulum stroke of the human heart. The eye was fallacious, the ear deceptive, fingers dull and the palate parched; but within the brain burned a clear, cold flame, as eternal as the vestal fire. "Je pense, puis je suis," is merely a reiteration of the famous saying attributed to the Jews but probably as old as the history of mankind. "In the beginning was the Word," Well may one cry with Ecclesiastes, "There is nothing new under the sun."

The birth of civilization in Europe was announced by the interest of men in ideas, although the latter were restricted in scope. The scholasts have been ridiculed for their adherence to worn-out shibboleths, but the fact remains that the mental dexterity acquired in defending or refuting a thesis, was a necessary preliminary to the development of calm observation of natural events. The dialectitian gave the scientist a foothold.

Man is the most thorough of animals. Unlike his humbler brethren he would pierce the fog of his origin and final bourn; know which winds wafted him here and the sea that will carry him home. The poet marvels at the revelation of natural phenomena; the philosopher gazes within his heart and sees, as in a crystal globe, the beating, thrusting pulse of humanity and over the crimson stream casts a web of thought. The scientist reveals the components of the stream. "This," he says, "is

a corpuscle. It is round, floats and measures seven microns."

In Mackenzie one sees with the precision of a ticking clock, the orderly progress from dreamer to master of himself and of environment and from the latter to dreamer again, but one whose final dream, like a huge whirlpool, scatters in centrifugal flight, the waves of youthful fancy. He, who was the most impassive of observers, becomes the reviler of mechanics. He, who studied the various components of the circulation, ignores the method that brought him fame and hearkens once more to the subjective, the voice of labile emotion, tempered by experience. Then with one dramatic sweep of his hand, like Canute commanding the waves, he orders Science to cease its irresistible flow and demands a return to the methods of the older clinicians, according to revised standards, his own. "Go to the ant, thou sluggard," becomes "Go to the sundew; healer of man-kind. Within this simple plant lies embodied all the cardinal impulses of life." He endeavours to teach science by analogy, failing to realize that he who would be inductive, the scientist, has now become deductive, the scholast; and like a poet, speaks in metaphors. He has betrayed himself, not knowing that Time had swung his heavy scythe and that ideas are a product, not only of cerebrum and environment but of the age-period, too. The resignation of the aged and of the defeated has unconsciously made a philosopher of him and he sees the world, not in a star, a mote of dust or a wee crimson tipped flower, but in the rhythmical sweep of the parasitical hairs of an insect-eating weed.

His attempt at the formation of a philosophy of Medicine is worthy of the ancients, but the greatest of these were content with impassive observation. Some, it is true, tried to find the eternal truth in water, others in fire, but Mackenzie was equally fallacious in his attempt to corral Truth and pierce her nostrils as though she were a bull and not an elusive wraith. He who had never admitted defeat, who had assailed poverty and conquered; ignored criticism and persevered; faced fame and did not yield, was humbled by the entrancing fire of Truth, that like a will-o-the-wisp led him into treacherous swamps, whose surface appeared firm and steadfast.

PROGNOSIS

The method of prognosis on which Sir James laid great stress has long been a possession of the profession. A tuberculous lesion, minimal in size, may progress rapidly to death. When first seen, prognosis is impossible until the factor of Time has been amply considered. There is no other way available at present to determine the virulence of the germ or the vulnerability of the mesenchyma and its derivatives. The speed of a horse is determined by timing. We have prognostic symptoms, but these unfortunately are but the premature tolling of a graveyard bell.

Many of the symptoms in a sick man can be referred to a common cause, and the idea arose that the production of symptoms was governed by definite laws and that if these were recognized it would be possible to classify symptoms according to their affinity in Nature. It seemed possible that in such a classification some principle might be found which would do for medicine what the atomic theory had done for chemistry.

Mackenzie refused to acknowledge the law of variability. The sea of symptoms usually penetrated the barriers of the nervous system and no medical mariner had as yet charted its course, its fluctuating emergence and recession, its reach and limits. Fatigue dulled pain, hunger, and thought. Dyspnea illogically replaced pain and at times was a constant substitute; a cheerful disposition minimized and the stupid failed to record events of great significance. One dealt, not with the abstraction, humanity, but with a sullen, vivacious, mute, hilarious, joyous, despairing, impassive, pugnacious crowd of jostling men and women.

We speak of schools of thought, of the varied cults and their glib reassurances, their floating isles of the Hesperides. We discuss the conflicting philosophies of man-

kind based on hope, guessing and an interlacing of truth. Poets may be satirical, dramatic or in the flush of youth and ignorance, lyrical. Messiahs come and go and the ravenous mob howls for fresh victims. Babylon lies in dust and maggots crawl in a queen's skull. An emperor's sceptre lies near his empty sockets and his bones mingle with the ashes of his slave. The Euphrates mocks ruined towers and in a flood of forgetfulness effaces the splendour of decayed grandeur. Rome lives in the ranting mouth of an opportunist and the prophets in the despairing gestures of a dying race. The glory of Pericles is subdued by the clamour of dubious successors and Egypt is noted only for that which thieves and vultures have spared. There is no stability. Even the dead moon plays with the tides and dust lives in the struggling, yearning leaves of grass. The immutable laws obey the greater law of change and the gods continuously spring from Jove's temple. Disease is as variable in its manifestations as the seething maelstrom of life, and the sick manifest themselves in dissimilar fashions. Classifications must be accepted only on the condition that they are not Truth, but its scaffold.

Thus, this great Scotsman, this renowned physician and hence universalist, in the greatness of his mind and courage, refused to accept the limitations of the intellect. Like Spinoza who enfolded God within his arms, he threw a shielding mantle of philosophy about the serried ranks of disease, and dying, felt that a definition had solved the meaning of chaos.

He had made remarkable contributions to learning, but peaked at the inadequacy of the most brilliant mind, discarded worth while facts to hearken concentratedly to the Lorelei of Philosophy. He substituted for the pillars of Truth, the deserted, ruined temples of a perished school of thought; he maintained to the end that he alone had found the true God.

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SURGICAL PROBLEMS

This department, for which the answers have been prepared by competent authorities, is maintained for the benefit of our subscribers. All queries must contain the name and address of the writer. Names will not be published.

Question: During the present road building program we are seeing numerous cases of cement burns. Our present method of debridement is not satisfactory. Could you suggest some way to prevent these burns? What in your opinion is the most satisfactory treatment?

Answer: In order to answer these questions, we must first describe the chemical constituents and chemistry of cement. When used without qualifications, it means Portland Cement. It is a hydraulic cement, in that, when set, it resists the action of water, and can under favorable conditions be allowed to set under water.

When pure chalk or limestone is burned (that is, heated in the kiln until a carbonic acid is driven off) it yields pure lime. This slakes violently with water, giving slaked lime, which can be made into a smooth paste with water and mixed with sand to form common mortar. However, if this lime is mixed in the presence of silica in the active form—that is, amorphous and hydrated—or with a silicate containing silica in an active form, it will unite with the silica and form a silicate of lime capable of resisting the action of water.

Hydrolic lime, and other cements of the Portland class, contains a great deal of uncombined lime and has to be slaked before it is used as a cement. In some places, the lime is slaked by the maker and rendered harmless; in other places, it is slaked by the user and sometimes causes burns, due to the inexperience of the slaker. The free alkalies combine with the tissue elements to form alkaline albuminate or with the fats to form soap, and in this way produce destruction of substance. They are also very hygroscopic and withdraw water from the cells, which contributes to the necrosis. The compounds which they form are very soluble: consequently the alkalies penetrate deeply. Their action continues for several days and is very painful: the scab which they produce is quite soft and the continued action leads to extensive scar formation.

Most of the commercial cement preparations are standardized by the government and are relatively uniform and free of uncombined alkali, having been slaked by the maker so as to be harmless to the user. However, it is possible that local brands may not be up to strict standards, and the presence of unslaked lime may give a lime burn. It would seem, therefore, that the first step in the prevention of these burns would be to make sure that all cement used is up to government standard and free from uncombined lime.

The treatment should be exactly like that for any other lime burn. First wash off with copious quantities of water: denude freely and remove all particles of cement. Neutralize with a 19 per cent solution of neutral ammonium-acetate. This may be applied as a wet dressing for about seventy-two hours. Then the part may be dressed with a cod liver oil ointment or tanned with tannic acid, 5 per cent solution.

In lime burns of the eye, all particles must be carefully removed and a 2 per cent ammonium chloride solution used as a neutralizer and applied at one-half hour intervals for the first twenty-four hours.

BOOK REVIEWS

A Woman Surgeon: The Life and Work of Rosalie Slaughter Morton. New York: Frederick A. Stokes, 1937. Price $3.

Dr. Morton has had a full and interesting life. She has been a pioneer in many fields, and experienced much. Her autobiography is both fascinating and an inspiration.

There is no need at this time to review the high lights of her career. She is known to physicians, especially those of her sex in medicine. She studied here and abroad, and worked in foreign countries. Professionally, she is known to Berlin, Vienna, Paris, London, Ceylon and India. She practiced in Washington, D. C., and New York, and now lives in Winter Park, Florida. Among her many accomplishments was the founding of the American Women's Hospitals. Dr. Morton, also, founded the International Serbian Educational Committee, under which sixty Yugoslav students were educated in American Universities. She has been decorated nine times and was awarded the Palm of Office of the French Academy.

A well written book; both physicians and laymen will find it well worth the time spent in reading it.

Synopsis of Anorectal Diseases. By Louis J. Hirschman, M.D., F.A.C.S. With 174 text illustrations and 6 color plates. St. Louis: The C. V. Mosby Co., 1937. Price $3.50.

This volume was written that the diagnosis and treatment of the commoner diseases of the anus and rectum could be offered in condensed form to the medical student and general practitioner. Chemical, pathological, and bacteriological details as well as historical references and bibliography have been curtailed if not entirely omitted. In this the author has shown discriminating judgment.

The book covers the practical high lights of anorectal diseases. Anatomy is given a chapter, and other chapters cover, Symptoms Which Should Call Attention to the Rectum, Examination of the Patient, Anaesthesia, Limitations of Local Anaesthesia and Office Treatment and Indications for Other Measures, Constipation and Obstipation, Fecal Impaction, Pruritus Ani, Anal Fissure and Ulcer, Abscess of the Ano-Rectal Region, Anal Fistula—Anal Sinus, Hemorrhoids, Ano-Rectal Polyposis—Anal Papillitis—Cryptitis, Proctitis and Sigmoiditis, Removal of Foreign Bodies, Benign Growths, and Rectal Stricture, and Prolapse of the Anus and Rectum.

A well done, indexed, book of 288 pages. We carried it about in our coat-pocket and read it between times. Unless one is an expert and thoroughly familiar with the subject, this book is recommended before consulting the larger textbooks.

Christian R. Holmes. Man and Physician. By Martin Fischer. Charles C. Thomas, 1937. Price $4.00.

This is a beautifully printed book. The publisher, Charles C. Thomas, deserves credit for offering physicians, especially the friends and admirers of the late Christian R. Holmes, a book, which is good to feel, to look at, and to read.

Martin Fisher has written a readable and interesting account of Dr. Holmes' active and worthwhile life. Dr. Holmes was the son of Holm Christiansen and Karen Mikkelsen, and was born in Engom, Denmark. The clerks in the immigration department constantly wrote his name "Holmes" and "the young Dane accepted [it] as the easiest way out when he became an American."

Young physicians would do well to read this life. It is an inspiration, and serves again, to prove the point that anyone can succeed if he has intelligence and the will to work. One day we will give our copy to a young man about to begin the practice of medicine; meanwhile, we will keep it conspiciously on our library shelves, so that we can be reminded of two facts; one, that a man came a poor immigrant to this country and rose to a high estate; the other, that now and then a particularly well made book, beautifully printed and bound, is turned out by an American medical publisher.

The Operations of Surgery. By R. P. Rowlands, F.R.C.S., ENG. and Philip

Turner, F.R.C.S., ENG. Eighth Edition. Volume 2. The Abdomen. Baltimore, William Wood & Company, 1937. Price $10.

When the first volume of this work, now in its eighth edition, appeared we reviewed it and gave the history of its growth and evolution up to the present time. Naturally, a Surgery that has lived for forty-eight years and gone through many editions and revisions must possess something out of the ordinary. Therefore, many will welcome this, the second volume.

It deals with Operations on the Abdomen.

The chapters on The Preparation of the Patient, Operations on Hernia, Operations on the Spleen, Operations on the Pancreas, and Operations on the Anus and Rectum were rewritten and revised by W. H. Ogilvie, F.R.C.S. (ENG.). The following chapters were rewritten and revised by A. Ralph Thompson, F.R.C.S. (ENG.): Operations on the Kidney and Ureter, Operations on the Bladder, Operations for Diseases of the Prostate, and Operations on the Urethra and Penis. Chapters on Injuries to the Pelvic Floor, Operations on the Ovary and Appendages, and Operations on the Uterus were rewritten by G. F. Gibberd, F.R.C.S. (ENG.); while the section on Thoracic Surgery in Chapter XXXII was written by R. C. Brock, F.R.C.S. (ENG.).

The illustrations are 514 in number (4 in color) and serve their purpose. The work throughout is well written. The Index is ample. Both volumes hit a high mark in excellence.

CANCER AND DIET. WITH FACTS AND OBSERVATIONS ON RELATED SUBJECTS. By Frederick L. Hoffman, LL.D. 1937. The Williams & Wilkins Company. Price, $5.00.

The author tells us that for twenty years or more, "the subject of diet has received [his] attention culminating in a fixed determination to initiate in due course an original study based on extended facts regarding living cancer patients and of course the required number of non-cancerous controls." Mr. Samuel S. Fels, of Philadelphia, supplied the financial assistance to make this work possible.

The author covers Dietary Theories of Cancer, The Modern Diet, Cancer Metabolism, Dietary Facts Concerning Cancer Patients, General Facts and Observations, and in Part Five there are a General Summary and Conclusions. Part VI contains Appendices, and deals with such topics as Questionnaire, General Instruction to Research Assistants, Sources of Dietary Standards, and Hydrochloric Acid and Lactic Acid in Relation to Gastric Cancer.

There are an Authors' and a General Index, and eight Charts. The book is 767 pages long.

Dr. Hoffman has done a thorough, important and needed work. To research workers and those whose work brings them into contact with cancer patients, and to students who wish a source for authoritative facts on this phase of the subject, this book stands in a class by itself.

The Publishers inform us that the price of the book—$5.00—is no more than half of the price justified by its cost, and that this price has been made possible by a generous subvention, making the book, in part, a gift to every purchaser.

GASTROSCOPY. THE ENDOSCOPIC STUDY OF GASTRIC PATHOLOGY. By Dr. Rudolf Schindler. With a preface by Dr. Walter Lincoln Palmer. 1937. The University of Chicago Press. Price, $7.50.

Dr. Schindler's work is universally known. Therefore, we welcome an authoritative work from his pen. The subject of gastroscopy has been a controversal one, but for the most part its opponents have been those who had little or no actual experience with it, or who argued in an abstract sense.

Dr. Schindler has written a good book. In it he covers thoroughly the subject and goes into details on all points. Beginning with the History of Gastroscopy, in twenty-one chapters he covers such subjects as; Technical Problems of Gastroscopy, Technic of Gastroscopy, The Gastroscopic Picture of the Normal Stomach, Disturbances of Motility and Secretion, Chronic Gastric Ulcer, Gastritis, Tumors, The Postoperative Stomach, Foreign Bodies, and The Relationship Between Gastroscopy and *X*-ray.

The illustrations are well done and a great help to the reader.

Dr. Palmer in his Preface says; "I am hopeful that the new method may be accorded the warm reception it so richly deserves by the conservative members of the profession and that it may be spared the fate of most new

methods—overenthusiasm and exploitation by the more radical supporters." And with this the reviewer heartly agrees.

This work deserves a wide distribution among physicians, surgeons, and especially those interested in stomach disorders. The method does not rival the *X*-ray examination but supplements it.

The book is 343 pages long, has 89 illustrations, and an ample Bibliography and an Index. At the end of the work is an Atlas consisting of 96 figures done in color with a full and detailed description of each figure. These colored illustrations alone are a valuable addition of the literature on the subject.

Surgical Treatment, a Practical Treatise on the Therapy of Surgical Diseases. By James Peter Warbasse, M.D., F.A.C.S. and Calvin Mason Smyth, Jr., M.D., F.A.C.S. In three volumes with 2486 illustrations on 2237 figures, some in colors. Second edition. Philadelphia and London, 1937. W. B. Saunders Company.

Many years ago, when we were younger, we purchased the first edition of this work by Dr. Warbasse, and found it satisfactory in every way. Others must have been of the same opinion, for it enjoyed a large and wide distribution.

Now, we are offered a second edition, thoroughly revised and reset, and although no significant departures have been made from the general plan of the original work, nevertheless it may be said to be a new work. This is because the volumes have been brought up to date, and so many new features and items added.

The section on blood transfusion has been rewritten, the many advances in the management of the syphilitic patient have been covered, and there is space devoted to the injection treatment of inguinal hernia. The chapters on physical agents in surgical treatment have been enlarged, and over seventy-five pages are devoted to the subject of anesthesia. Diseases of the thorax, cranial trauma and the treatment of fractures have been revised and modernized, while the chapter on "classical amputations" have been deleted.

New drawings (the illustrations are of a high order) have been added, and a separate small volume is devoted to a General Index.

A practical, solid, worthwhile work, it deserves to repeat its earlier popularity.

Handbook of Orthopaedic Surgery. By Alfred Rives Shands, Jr., M.D. In collaboration with Richard Beverly Raney, M.D. With 169 illustrations. 1937. The C. V. Mosby Company. Price $5.00.

This book, written for the medical student and general practitioner, presents the fundamentals of orthapedic surgery in a concise manner, and yet in sufficient detail to cover thoroughly the essentials of the subject.

The authors have presented the consensus of opinion as recorded in standard textbooks on the subject and in the recent literature, "criticized and tempered with the experience and thought of twenty four teachers of orthopedic surgery and allied subjects representing eighteen different medical schools." We are informed that each chapter was revised by more than one authority. Due to limitation of space certain parts of orthopedic teaching have been omitted, among these are such subjects as fresh fractures, plaster technic, and orthopedic apparatus.

The subject matter has been divided in twenty-four chapters in accordance with a report of the Committee on Undergraduate Instruction in Orthopedic Surgery of the American Orthopedic Association. The first chapter on chronic arthritis has been taken from the Arthritic Primer, and the chapter on the low back is a modification of Dr. Steinler's, "Diseases and Deformities of the Spine and Thorax."

This book is well written. The illustrations are good. All in all, we can think of no better work on this subject for the medical student and man in general practice.

Preoperative and Postoperative Treatment. By Robert L. Mason, M.D., F.A.C.S. Illustrated. Philadelphia and London, 1937. W. B. Saunders Company. Price $6.00.

The author has written a worthwhile and practical book on a detailed consideration of the preparation and after-care of surgical patients. Also, he has called upon a number of his friends to write chapters upon subjects which lay within their special fields of interest.

The Massachusetts General Hospital granted permission to reproduce portions of the diet manual of the hospital.

Part One has chapters on: Conditions Affecting the Operative Risk, The Surgical Risk and Management of Patients with Heart Disease, Hypertension and Nephritis, Preoperative and Postoperative Care of the Surgical Patient with Diabetes, Anaesthesia, General Preparation of the Good Risk Patient, Postoperative Care After the Uncomplicated Abdominal Operation, Shock, Blood Transfusion, Water Balance and Methods of Parenteral Administration of Fluids, Acidosis and Alkalosis, Adynamic Ileus, Acute Dilatation of the Stomach, Care of the Wound, Disruption of the Abdominal Wound, Postoperative Pulmonary Complications, Postoperative Peritonitis, Postoperative Parotitis, Thrombosis, and Superficial Burns. Part Two has chapters covering: Preoperative and Postoperative Care in Diseases of the Ear, Nose and Throat, of the patient with Hyperthroidism, in Diseases of the Gall-bladder and Biliary Tract, in Gynecology, in Urological Surgery, Acute Empyema Thoracis and Subphrenic Abscess, Appendicitis, Intestinal Obstruction, Hernia, Traumatic Injuries, Pre and Postoperative Care in Orthopedic Surgery and in the Surgery of the Colon and Rectum, and an Appendix covering Normal Chemical Standards.

There are 123 illustrations and an Index.

A book that not only the interne and young physician can read and study with profit, but one that the older, so-called surgeon of experience might well consider without feeling he is re-covering all too familiar ground.

Legal Medicine and Toxicology. By Thomas A. Gonzales, M.D., Morgan Vance, M.D. and Milton Helpern, M.D. With a foreword by Harrison S. Martland, M.D. New York, 1927. D. Appleton-Century Company. Price $10.

This is an important book and no doubt will be considered one of the outstanding reference works on this subject in this country. In the preface the authors' affirm; "The aim of the authors has been to prepare a book which would be sufficiently complete to use as a satisfactory source of reference but brief enough to serve the student as an introduction to mediolegal science."

The book is divided into sections on legal medicine and toxicology. The subjects which are considered a part of medical jurisprudence, such as the corpus delicti, the responsibility of the physician to the government, malpractice, insanity, and insurance are thoroughly discussed. The routine work of medical examiners, coroner's physicians, or similar officials are considered in detail. Special technical processes used in medicolegal investigations, finger printing, the science of ballistics, and pathological lesions encountered at autopsy are covered thoroughly. In a separate section the study of poisons is considered.

At the end of each chapter is an outline of the Literature for those who would go further into a given subject.

This book of 754 pages has 241 illustrations, some in color, an Appendix on Organization and Procedure of the Office of the Chief Medical Examiner of the City of New York, and an Index.

Besides being a solid, authoritative work, the reviewer found it better reading than current best-seller crime and mystery stories.

Diseases of the Nose and Throat. A Textbook for Students and Practitioners. By Sir St. Clair Thomson, M.D., F.R.C.P. (Lond.) and V. E. Negus, M.D. Lond., F.R.C.S., (Eng.) Fourth edition. With 12 colour and 16 radiographic plates and 386 figures. New York, 1937. D. Appleton-Century Company. Price $14.

The last edition of this book appeared ten years ago. It was first published twenty-five years ago, went into a second and third edition, and several reprintings. Within the last decade the developments in laryngology have been so marked that the author decided to bring it abreast of the times, and obtained the co-operation of his friend V. E. Negus to aid in this endeavor.

The general scheme of the work has been preserved but certain chapters have been cut down, while other chapters have been rewritten and enlarged. Certain illustrations have been replaced by better ones and others have been altered. Per-oral endoscopy has been entirely re-written by Negus as a separate chapter. The space allotted to intubation has been curtailed, while that given to tracheotomy

has been increased and given some new illustrations.

A book that has lived a quarter of a century, gone through three editions and many printings, needs no special introduction when a modernized fourth edition is offered the medical profession. Anyone doing special work in Nose and Throat, and the general man who desires a book in his library on this subject, will find this work one of the leaders in its field.

Surgical Pathology of the Thyroid Gland. By Arthur E. Hertzler, M.D. 238 illustrations. Philadelphia and London, 1937. J. B. Lippincott Company.

This is the latest Monograph on Surgical Pathology by Arthur Hertzler. Seven volumes have preceded this one on the pathology of the thyroid gland. Two more are to follow, Surgical Pathology of the Diseases of the Neck, and of the Mouth and Jaw.

In this volume, the author covers chapters on General Considerations, Morphology of the Thyroid Gland, General Pathology of Goiter, Nontoxic Diffuse Goiter, Nontoxic Nodular Goiter, Toxic Nodular Goiter, The Cardiotoxic Goiter, Toxic Diffuse Goiter, Thyroiditis, Myxedema, Fetal Adenomas, and Tumors of the Thyroid Gland.

The surgeon interested in this subject (and the internist, also) will find this book a storehouse of valuable facts and observations. The book is 298 pages long, the illustrations are well done, and the Index is ample.

Recent Advances in Orthopedic Surgery. By B. H. Burns, B.Ch., F.R.C.S. and V. H. Ellis, B.Ch., F.R.C.S. With 108 illustrations. Philadelphia, 1937. P. Blakiston's Son & Co. Inc.

We can do no better than to quote from the Preface: "This book is not intended in any sense as a text-book, as it assumes some knowledge of standard orthopedic practice. Rather, we have attempted to discuss the present attitude to certain problems. We think the views we have stated are largely in accord with current thought in this country, or, at any rate, in London, and we have extensively drawn on the work of foreign experts where this has appeared to us to be significant. . . . Our views will, we hope, be helpful to some, whilst to others they may be an irritant, perhaps amounting to a stimulus. . . . We have, as far as possible, dealt with the application of principles rather than details of technique."

The book is particularly well written. The illustrations are above average. The physician limiting his work to orthopedic surgery will read this small, indexed book of 296 pages with both pleasure and profit.

PRACTICAL CLINICAL GYNECOLOGY

HENRY C. FALK, M.D., F.A.C.S.

SEVENTH INSTALLMENT

CONTENTS

[This Issue]

Chapter		Vol. xxxvii Page
xii.	Ectopic Pregnancy	549

[Previously Issued]

		Vol. xxxv
i.	Examination of the Patient	153
ii.	Preoperative Hospital Routine; Preparation of the Patient; Postoperative Hospital Routine	172
iii.	Abortion	187
iv.	Gonorrheal Infection of the Tubes	629
		Vol. xxxvi
v.	Fibroids	559
vi.	Retrodisplacements of the Uterus	750
vii.	Menstruation and Its Disorders	766
		Vol. xxxvii
viii.	Sterility	143
ix.	Ovary	351
x.	Endometriosis	363
xi.	Carcinoma	371

CHAPTER XII

ECTOPIC PREGNANCY

The nidation of a fertilized ovum outside of the uterine cavity is called an ectopic or extra-uterine pregnancy. As a rule the terms ectopic pregnancy, extra-uterine pregnancy and tubal pregnancy are used synonymously, although properly speaking tubal pregnancy should be reserved for pregnancies occurring in the tube. Ectopic pregnancy covers any pregnancy that is outside the uterus, whether it is intra-abdominal, intra-ligamentous, ovarian or tubal.

ETIOLOGY

It is assumed that the ovum is normally impregnated in the ampullary portion of the tube. The spermatozoa take approximately two days to travel from the cervix to the ampullary portion of the tube. The impregnated ovum requires three days to travel through the tube and reach the uterine cavity. It then rests in the uterine cavity for seven days before nidation takes place; thus approximately ten days elapse after impregnation of the ovum before nidation takes place. (Fig. 132.)

When the ovum is extruded from the ovary, it is surrounded by the zona pellucida and a few cells of the corona radiata. Their exact function is not definitely known. Some observers believe that these structures act as a pabulum for the impregnated ovum until nidation takes place; so that when this food has been consumed the ovum must become parasitic or die. Whatever the factor is that causes nidation and from whatever source the ovum derives its nutrition until nidation takes place, it is fair to assume that the inherent nutrition can keep the impregnated ovum alive for only a short period of time (ten days) and at the end of this period, the ovum must imbed itself to obtain food.

What bearing has this upon the etiology of ectopic pregnancy? Anything, be it within or outside the tube, which

interferes with the normal descent of the ovum, causing it to remain in the tube until it reaches that point in its development when it must imbed itself, will cause a tubal pregnancy.

In a normal uterine pregnancy, before nidation occurs the endometrium gives off a substance known as "uterine milk." This is supposed to act as a pabulum for the ovum for the seven days during which it is lying quite free in the uterine cavity. No such substance has ever been found to be produced by the tube. Therefore it is reasonable to assume that if the descent of the ovum through the tube is impeded, the ovum, lacking this additional food, would imbed itself earlier in the tube than it does in the uterus.

What are the factors which interfere with the normal descent of the ovum? Examination of any textbook of gynecology will show one or more pages devoted to the etiological factors in ectopic pregnancy. Tumors, angulations of the tube, congenital anomalies of the tube (long tubes, diverticulae of the tube, blind ostia, etc.) are mentioned. A careful histological study of the proximal end of the involved tube, in fifty cases of ectopic pregnancy at Harlem Hospital, showed evidence of the end results of some form of low grade infection in 95 per cent of the cases.*

What are the late results of a low-grade infection? A patient develops an acute gonorrheal salpingitis. If this infection is severe, it may cause a complete destruction of the epithelial elements in the tube with a scar tissue closure of the lumen after the infection subsides. This rules out any possibility of a pregnancy on that side. This same infection may close the fimbriated end of the opposite tube; thus the patient becomes sterile. However, all forms of gonorrhea are not of the same virulence. Assuming that the infection is of a milder character or that the patient is resistant to the particular gonococcus with which she is infected, what happens? Healing

* Follicular salpingitis an important factor in the etiology of ectopic gestation, H. C. Falk. *Am. J. Obst. and Gyn.*, 15: 821, 1928.

takes place with the formation of pseudogland-like spaces (Fig. 133) and follicular salpingitis (tubal labyrinth). See page 74 and Figures 42, 43 and 44. Reconstruction of these

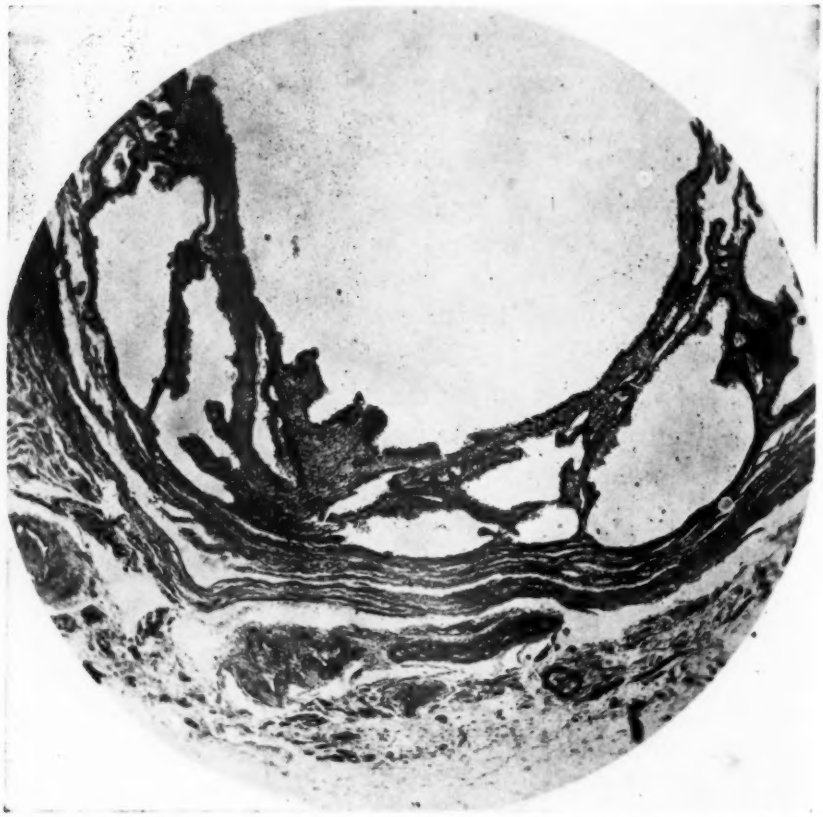


FIG. 133. Pseudoglands or tubal labyrinth along the wall of the tube. (Falk. *Am. J. Obst. & Gynec.*, 15: 821, 1928.)

pseudogland-like spaces shows that:

1. They usually run parallel to the lumen of the tube,
2. They may be open at both ends (Fig. 134A),
3. They may be closed at both ends (Fig. 134B),
4. They may be open at one end and closed at the other. (Fig. 134C.)

Follicular salpingitis not only follows mild attacks of gonorrheal salpingitis but may develop following any low-grade infection in the tube; e.g. the use of intra-uterine contraceptives, instruments, iodine to destroy pregnancy before imbedding takes place, induced abortions, etc.

Question: Does this mean that every woman who has had a low-grade or gonorrheal infection of the tube, either is sterile or has an ectopic?

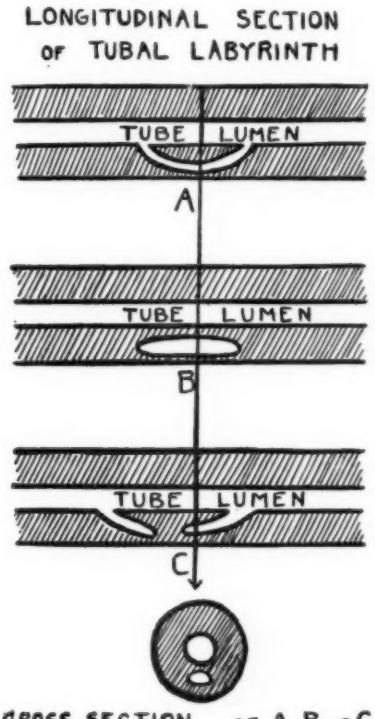


FIG. 134. Diagrammatic reconstruction of pseudogland-like spaces; follicular salpingitis, tubal labyrinths with cross section of pseudogland-like space.

Answer: No. When the infection has disappeared, the lumen of the tube may be restored to a fairly normal state. Some folds may have disappeared and many small gland-like spaces may have developed, but the lumen of the tube (Fig. 133) is ample to allow an impregnated ovum to descend to the uterus.

Question: How do these pseudogland-like spaces interfere with the descent of the ovum?

Answer: The impregnated ovum may descend through the lumen of a previously infected tube, if the luminal space is

ample, allowing the possibility of an intra-uterine pregnancy. But should the ovum be caught in one of the pseudogland-like spaces and be held there until that point in its development is reached when imbedding must take place, a tubal pregnancy would occur.

Before attempting to discuss the imbedding of the ovum in tubal pregnancy, several factors must first be understood, namely:

1. That the activity of the ovum in imbedding itself would not differ materially in its method of attack whether it be in the uterus, tube or elsewhere.

2. That physiologically and histologically the tubal mucous membrane differs from the uterine endometrium. It undergoes no regular preparation for the reception of an impregnated ovum. There is no thick endometrium into which the ovum may imbed itself.

3. That the stroma of the tube is very scant, and usually does not undergo decidual changes to resist the digestive action of the trophoblast of the ovum.

4. That in the tube there is no thick muscular wall to hypertrophy and stretch around the ovum.

If the theory that the end-result of a low-grade infection is the etiological factor in most tubal pregnancies is accepted, one may assume that the ovum might be blocked by an adhesion (Fig. 135A) or become lodged in the open end of a pseudogland-like space and begin development there. (Fig. 135B.) The ovum follows a definite course in its imbedding, and it is this course which influences the pathology and symptomatology which the patient will present.

When the blastocyst imbeds itself, it must be assumed that it attacks the tissues of the tube in much the same way as it does the tissues of the uterus. In the uterus, Teacher states, "the embryo destroys the uterine epithelium in its immediate neighborhood and the underlying tissues to an extent sufficient to open the maternal vessels." "The maternal blood flows from the opened vessels into spaces in the primitive ectoplacenta but more into a space between it and the decidua."

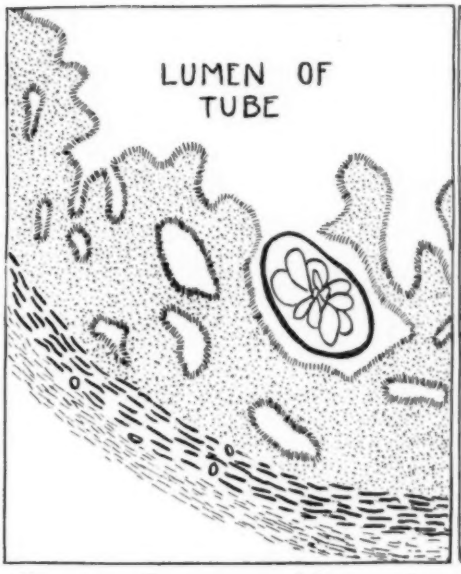


FIG. 135A. Ovum arrested by an adhesion in between the folds of the tube. Imbedding process begun at point of arrest.

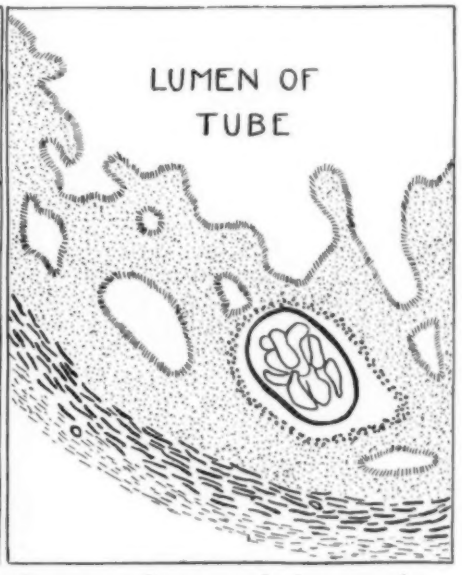


FIG. 135B. Ovum caught in a pseudo-glandlike space. Imbedding process begun at that point.

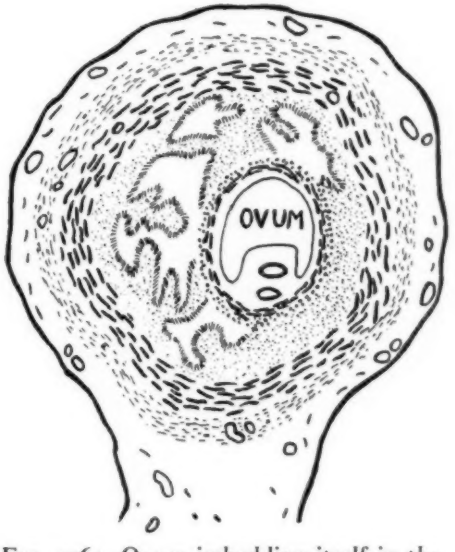


FIG. 136A. Ovum imbedding itself in the tube showing the major portion of the growth towards the lumen of the tube.

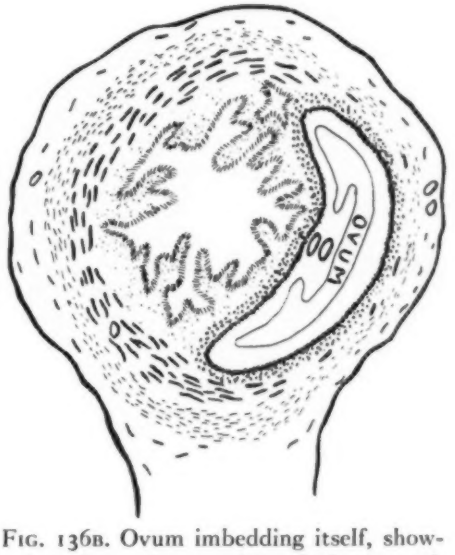


FIG. 136B. Ovum imbedding itself, showing the major portion of the growth towards the wall of the tube.

This bleeding in the uterus is into a closed space, as the penetration point in the endometrium has closed over the ovum. The trophoblast prevents the blood from coagulating

FIG. 137A. Microphotograph of a cross section of an ectopic pregnancy of the luminal type of imbedding.

and ultimately the blood finds its way back into the maternal circulation.

As soon as the ovum has gained its foothold in the tube it grows in one of three ways: (1) The major portion of the growth may be toward the lumen of the tube (Fig. 136A.) (2) The major portion of the growth may be toward the wall of the tube. (Fig. 136B.) (3) The ovum may grow equally in both directions, toward the lumen and toward the wall. These three types are not always sharply demarcated from each other.

In the first type of imbedding the ovum grows toward the lumen of the tube, the small portion of tube wall between the

ovum and the tube lumen is quickly dissolved, and the growing ovum projects into the cavity of the tube. This is called the *luminal type* of imbedding. (Fig. 137.) The ovum in this type

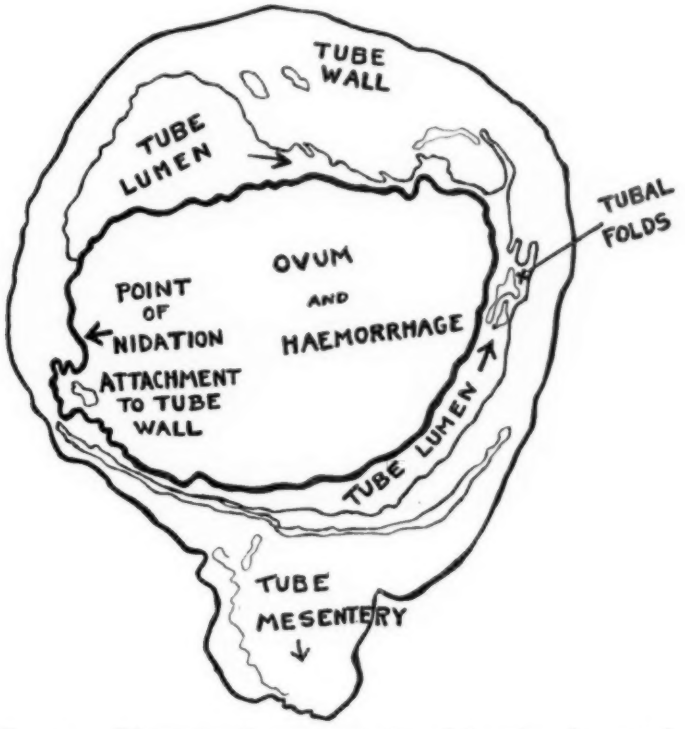


FIG. 137B. Diagrammatic representation of the microphotograph 137A showing the luminal type of imbedding. (Falk. *Am. J. Obst. & Gynec.*, 15: 821, 1928.)

has only a moderate attachment to the wall of the tube. The trophoblast of the ovum attacks the folds of the tube in its search for vessels for pabulum for the ovum. Wherever the trophoblast comes in contact with the tubal epithelium, the latter disappears. (Fig. 138.) As the ovum projects into the lumen of the tube between the folds, it does not lie in a closed space as is the case when the ovum is imbedded in the endometrium. Therefore, when the first small capillaries of the folds of the tube are opened and hemorrhage takes place, this blood surrounds the ovum and a definite portion of the blood goes directly into the lumen of the tube. It is this hemorrhage which may go forward (Fig. 139) and appear at the vulva,

or go backward and be expelled from the fimbriated end of the tube into the peritoneum. It is agreed that in a fair proportion of cases the appearance of blood at the vulva is usually of

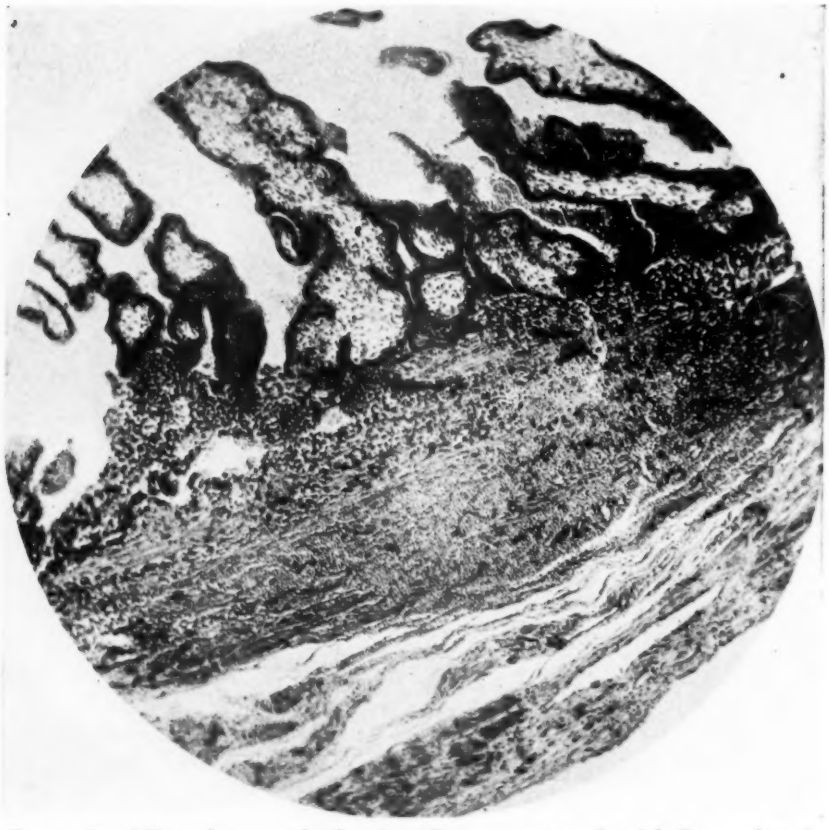


FIG. 138.—Microphotograph showing disappearance of epithelium when it comes in contact with trophoblast of the villi—luminal imbedding. (Falk. *Am. J. Obst. & Gynec.*, 15: 821, 1928.)

uterine origin and means either death or separation of the fetus from its bed, but in a certain number of cases the blood must be of tubal origin. *It is the initial hemorrhage into the tube which gives rise to the first symptoms of tubal pregnancy either by peritoneal irritation from the blood or by sudden distention of the tube.*

The luminal type of imbedding rarely goes on to rupture. It is usually operated upon with a diagnosis of an unruptured tubal pregnancy, or a tubal abortion. When the ovum develops

in its normal, rather slow growth, particularly if the placenta forms toward the broad ligament side, the tube, in the luminal form of implantation, accommodates itself to the gradual

FIG. 139. Cross section of the tube close to the uterine end, showing the canal filled with blood.

growth of the ovum and the pregnancy may in rare instances go on to or near term. As a rule, however, hemorrhage takes place, causing a sudden distention of the tube. An acute abdominal crisis develops and operation is usually performed with or without the proper diagnosis. It is the bleeding, causing sudden distention of the tube or irritation of the peritoneum, which gives the symptoms. *An ectopic pregnancy gives no symptoms until hemorrhage takes place.*

In the second type, the ovum eats its way into the wall of the tube, imbedding itself as it does in the uterus. This is called the *mural type* of imbedding. As there is no thick mucosa into which the ovum may imbed itself, as is the case in the uterus, the ovum eats its way into the muscular wall of the tube. (Fig. 140.) In the mural imbedding, when the trophoblast opens the capillaries and hemorrhage takes place, it is into a closed cavity similar to the endometrium and there is, therefore, no external bleeding into the peritoneum or into the lumen of the tube. If the vessels are small and the hemorrhage is slight, it acts as a pabulum for the developing ovum. If the vessels are larger, the hemorrhage may destroy the ovum

and a tubal mole develop. This entire process may give the patient very few or no symptoms. Should the ovum continue to grow, the villi invade the musculature of the tube. Deciduae

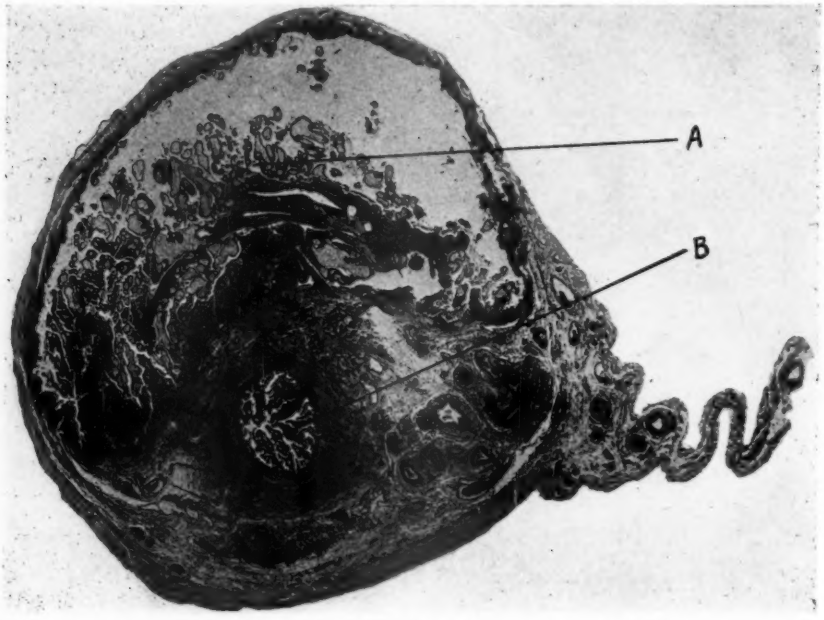


FIG. 140. Very early tubal pregnancy showing mural imbedding. A, ovum in wall of tube. B, tube lumen. (Falk. *Am. J. Obst. & Gynec.*, 15: 821, 1928.)

formation is infrequently found in the tube (Fig. 141); therefore, the resistance to the invasion of the trophoblast is minimal. Areas are found in the tube where cells of the trophoblast are almost directly under the serosa—in fact they may actually eat through the serosa making a small opening through which hemorrhage later takes place into the peritoneal cavity. Frequently before the erosion has extended far enough to eat away a substantial part of the tube wall, a fairly large-sized blood vessel is opened, and the hemorrhage into this closed space ruptures the thin wall of the tube with a sudden expulsion of a large quantity of blood into the general peritoneal cavity. It is this type that gives the clinical picture of the tubal catastrophe. Occasionally the rupture, instead of going toward the peritoneum, may take place into the lumen of the tube, in which case the ovum is either killed or aborted

into the lumen. If it is aborted into the tube and not killed by the hemorrhage, the ovum may continue to grow in a manner similar to the luminal or combined form of imbedding.

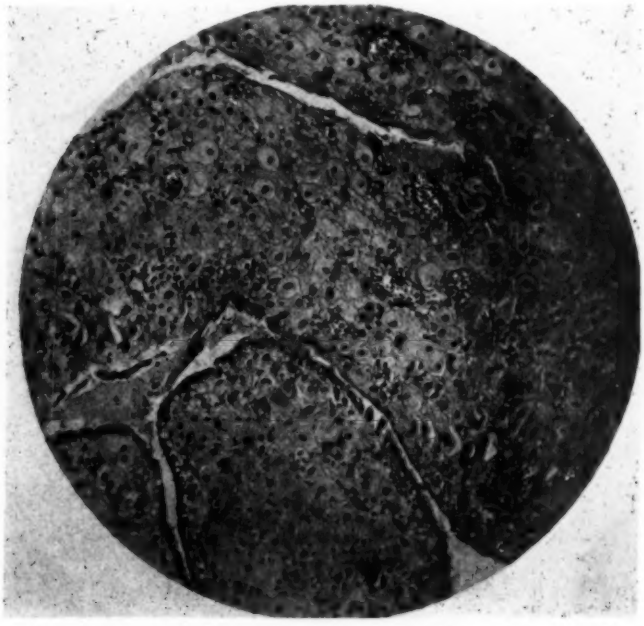


FIG. 141. Decidual reaction in tubal fold in case of tubal pregnancy.

The third form of imbedding is a combination of the two forms already described. The ovum having lodged itself begins to grow, partially imbedding itself into the wall of the tube and also projecting into the lumen. This third form is called the *luminomural* or *muroluminal* according to which type of growth predominates the picture. Its clinical course may follow either the luminal or mural type, depending upon whether the phagocytic action of the trophoblast in eating into the wall of the tube, or the growth of the ovum into the lumen of the tube, predominates. This form of imbedding occurs in the majority of tubal pregnancies.

It is not unusual, in examining serial sections of early tubal pregnancies, to see evidences which point to the possibility of a pregnancy beginning as a mural type, gradually surrounding the lumen of the tube, ultimately digesting it, and con-

verting itself into a luminal form. (Figs. 142 and 143.) The three types frequently overlap.

To what degree can (a) point of implantation of the ovum,

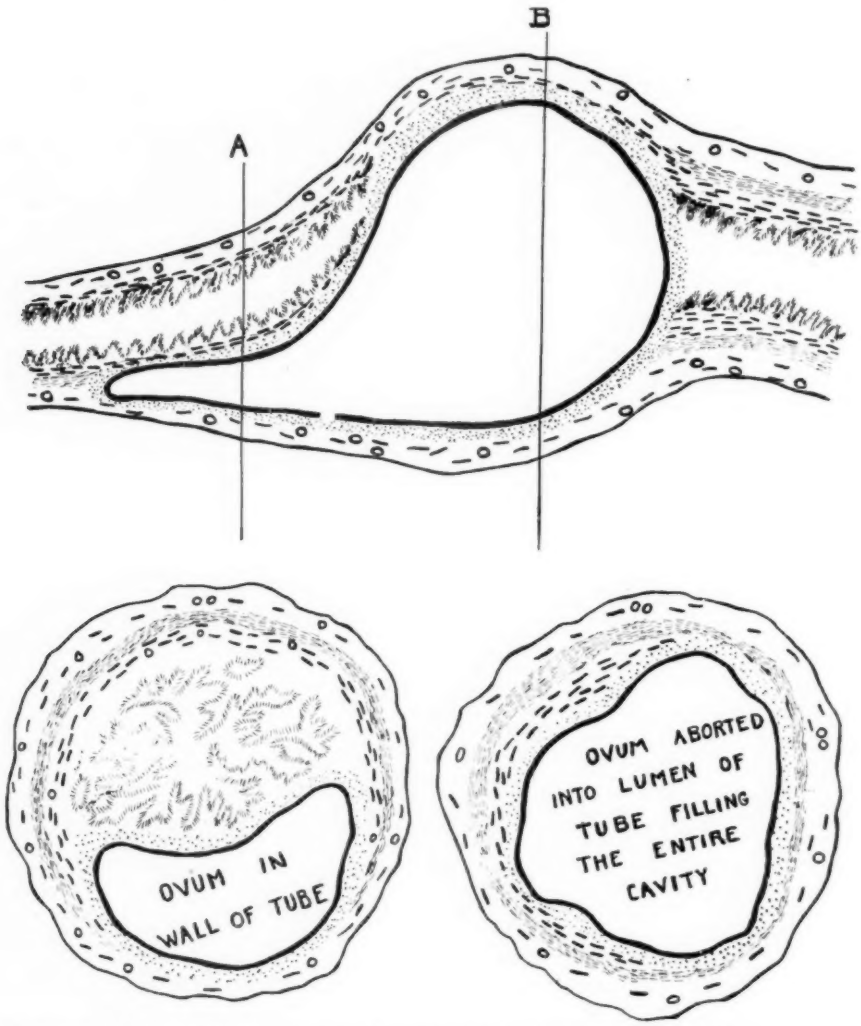


FIG. 142. Diagrammatic reconstruction of serial sections of early ectopic pregnancy showing mural type, rupturing into the lumen of the tube, and how single sections taken at A or B would give entirely different microscopic pictures. (Falk. *Am. J. Obst. & Gynec.*, 15: 821, 1928.)

(b) type of imbedding, and (c) extent of hemorrhage be correlated?

The closer one approaches the isthmus of the tube with its less complicated stroma and its thicker wall, the more apt is

one to see the mural, or muroluminal type of imbedding with tubal rupture as a consequence. The nearer the imbedded ovum is to the uterine end of the tube the more frequently

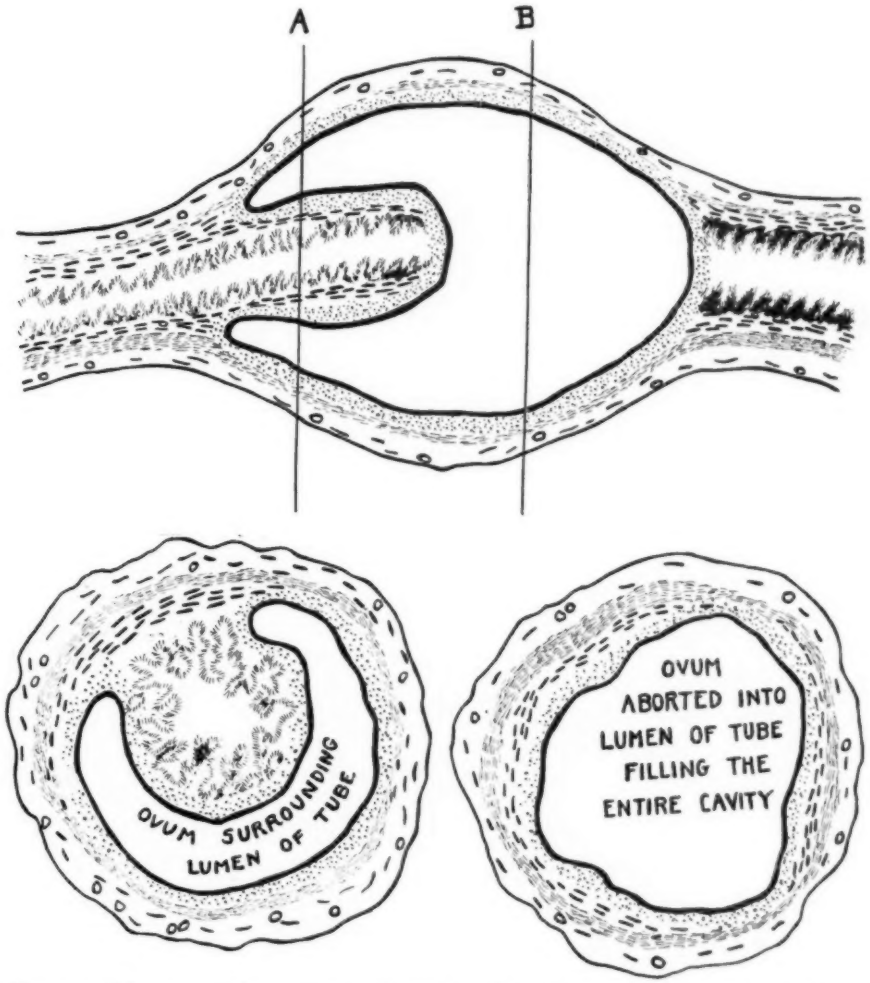


FIG. 143. Diagrammatic reconstruction of serial sections of early pregnancy showing another method whereby the mural type of imbedding surrounds the lumen of the tube, ruptures into it. Single sections at A and B show an entirely different microscopic picture. (Falk. *Am. J. Obst. & Gynec.*, 15: 821, 1928.)

does the pregnancy end in a ruptured tube with acute abdominal catastrophe.

The closer the implantation of the ovum to the fimbriated end of the tube the more profuse the hemorrhage, because the vessels are larger and there is very little obstruction to the

outflow of the blood toward the peritoneum. Due to this profuse hemorrhage, free into the peritoneal cavity, these patients may present all the symptoms of a tubal rupture catastrophe although no rupture has taken place. This clinical picture, although it may occur, is rather unusual. The ampulla with its many branching folds, its rich stroma and its very thin wall of muscular tissue is more apt to have either the luminal or luminomural imbedding. The pure mural type of imbedding practically never occurs here. If the ovum is implanted near the fimbriated end of the tube, it is usually luminal. The growth of the ovum plus the pressure of the hemorrhage behind it, assisted by the peristaltic action of the tube, may expel the ovum into the peritoneal cavity, without destroying it and without severe hemorrhage, thus giving rise to a secondary abdominal pregnancy. When the luminal implantation is toward the middle of the tube or near the uterine end, and hemorrhage takes place into the lumen of the tube, the flow of blood toward the peritoneal cavity is retarded, due to clotting of the blood in the tube before expulsion. The hemorrhage in implantation in this portion of the tube may cause sufficient pressure upon the ovum to produce the death of the ovum with the formation of a tubal mole. Tubal moles generally do not come to operation and may not be discovered until a laparotomy is performed for resulting or other pathology.

Very rarely a tubal pregnancy may rupture between the layers of the broad ligament without a single drop of blood being present in the peritoneal cavity. Two cases of this type have been observed at Harlem Hospital: the first case was associated with a tremendous hemorrhage between the layers of the broad iigament; in the second case the hemorrhage was much less in amount.

If the pathology of the imbedding of the ovum in tubal pregnancy is clearly understood by the clinician, he can make a more accurate diagnosis and can better evaluate the symptoms which the patient with a tubal pregnancy presents.

Question: What, if any, is the relationship of the ovum to the etiology of ectopic pregnancy?

[278]

Answer: Some men lay a considerable amount of stress on the ovum as an etiological factor in tubal pregnancy, owing to the fact that Mall in his study of tubal pregnancies found normal ova in only 16 per cent of his cases. In 25 per cent, he found pathological embryos and in 59 per cent he found pathological ova. Whether or not the pathology found in the ovum is the result of improper nidation or the improper nidation is caused by an abnormal ovum, one cannot say. But it is a fact that a large number of abnormal ova and embryos are found in tubal pregnancies.

Question: Does the form of imbedding have any relationship to the part of the tube in which nidation occurs?

Answer: If a tube were divided into three portions, an outer, a middle and an inner part, the closer one comes to the uterus, the more apt one is to have the mural type of imbedding. The nearer one comes to the fimbriated end of the tube, the more apt is one to find the luminal type of imbedding. In the middle part of the tube the forms of imbedding occur about equally.

Question: How do you account for repeated ectopics?

Answer: With an understanding of the etiology and the pathology as described, one may say that repeated ectopics or a recurrence of an ectopic in the same tube which was resected at a previous operation, can occur, because the basal tubal pathology is still present.

Question: What is the relationship between the form of nidation and the clinical course which the case may follow?

Answer: In the luminal type one rarely sees a rupture of the tube. If the ovum grows normally and no large hemorrhage takes place, the tube gradually distends to accommodate the ovum. It is this type which is frequently diagnosed as an unruptured ectopic. Rarely, hemorrhage with a sudden distention of the tube may cause this type of imbedding to rupture.

In the mural type of imbedding there is a marked thinning of the wall with occasional erosion. In these cases, owing to the thinness of the wall, hemorrhage frequently causes tubal rupture

with all the associated tragic symptoms of shock and hemorrhage.

In the third type, luminomural or muroluminal, the course depends upon which type of imbedding is the more prominent.

At operation it is frequently difficult to recognize the type of imbedding owing to the hemorrhage, which is often so profuse as to destroy all the evidence of the early pathology.

Irrespective of the type of nidation, if a very early hemorrhage takes place and destroys the life of the ovum, it stops growing, a tubal mole develops and all symptoms cease.

SYMPTOMATOLOGY

In order to have a better understanding of the relationship between the pathological conditions produced and the history and symptomatology of any case of ectopic pregnancy, the present discussion will consider pathology, symptomatology and history simultaneously.

I. Ectopics Give a History of Previous Infection, Inflammatory Disease, Intra-uterine Instrumentation, Appendicitis, Etc. A history of a previous pelvic infection would account for the pathological factors necessary to produce follicular salpingitis. Appendicitis or other extra-genital infection could cause peritubal adhesions, kinking, etc., which could retard the normal descent of the impregnated ovum.

II. Ectopic Pregnancy as a Primary Pregnancy in a Woman Who Has Had a Very Short Sex Life, Is Infrequent; Ectopics Occur in Individuals Only after a Moderately Long Sex Life or after Exposure to Some Form of Low-grade Infection. When the history is very carefully taken and the patient is absolutely honest, the incidence of an ectopic as a first pregnancy or a pregnancy early in sex life, without a history of a previous pelvic infection, is practically nil; the reason being that ectopic pregnancy occurs as a late result of some form of low-grade infection causing pseudogland-like spaces in the tubes. In the history, patients will state that the ectopic is the first pregnancy, but on close questioning it will be found that

they have been having sex life for two or more years; or that they have been practicing various forms of contraception, such as the use of a wishbone pessary in the uterus; or that they have had one or two curettages. These various factors may have produced the necessary low-grade infection.

Ectopic pregnancy occurred as a first pregnancy in 48 of our 313 cases, or in about 15 per cent. Our statistics, however, did not take into consideration the length of sex life.

In Russia, where abortion is now legalized, it was found that there was a three-fold increase in the number of ectopic pregnancies, showing that even under the best surgical asepsis, abortions may cause some form of low-grade infection of the tube with resultant pseudogland-like spaces.

III. A History of Previous Sterility. An extended period of sterility occurs very often in patients with ectopic pregnancy. This history of sterility is as a rule an enforced sterility with the use of contraceptives. A history of one-child sterility may be obtained in ectopic pregnancies. This is usually due to the fact that with the primary impregnation the patient was infected, and this low-grade infection gave her the necessary tubal changes which brought about follicular salpingitis.

IV. A Missed Period or Amenorrhea. Tubal pregnancy in its earliest stages (e.g. before any hemorrhage takes place) gives all the signs and symptoms of a normal intra-uterine pregnancy. The first symptom of pregnancy that the patient will notice will be a missed period. This occurs equally with early intra-uterine or extra-uterine pregnancy. In only 15 per cent of our cases was there no history of a missed period. These patients presented the acute abdominal symptoms necessitating operation before the onset of the next period. This however, is the exception and not the rule.

V. Anomalous Period. When the ovum is normally imbedded in the uterus, no anomalous vaginal bleeding occurs. This is because in the normal intrauterine pregnancy the ovum imbeds itself completely in the endometrium, so that when the trophoblast opens a blood vessel, the hemorrhage which takes

place is into a closed space and the ovum uses this blood for nourishment. When abnormal bleeding does occur, it is due to an anomalous imbedding with threatened abortion.

In tubal pregnancy, however, anomalous bleeding is due to several causes. In the luminal type of imbedding (Fig. 137) the ovum erodes the folds of the tube in an attempt to find blood from which it will obtain its nourishment. When a blood vessel is thus opened and hemorrhage takes place, it is not in an enclosed space or a closed cavity as in the uterus, but it is expressed directly into the lumen of the tube. This blood, if proximal to the ovum, may go down the lumen of the tube and out through the uterus, giving an anomalous period. (Fig. 139.) The blood distal to the ovum will go toward the peritoneal cavity. In this type of anomalous bleeding the blood in the vagina has a dark red color. It seems like old blood; it looks quite black. *This dark vaginal blood is typical of ectopic bleeding.*

In the mural type of imbedding the ovum imbeds itself in the wall of the tube. When a vessel is eroded, it bleeds into a closed space similar to the uterine imbedding; thus it cannot produce this type of abnormal bleeding. In the combined type—lumino-mural or muro-luminal—if the cavity of the tube communicates with the pregnancy, the same kind of tubal bleeding presenting in the vagina, described in the pure luminal imbedding, may occur.

There is another type of anomalous bleeding which is bright red and is of uterine origin; this occurs when the ovum is separated from the tubal wall by hemorrhage, thus allowing the inhibitory action of the corpus luteum to cease, if only for a short time. This loss of inhibition allows uterine bleeding to occur, which bleeding occurs at an anomalous time and is bright red in color.

Should the ovum become completely separated or die, and stimulation of the corpus luteum cease entirely, a complete separation of the uterine decidua takes place with vaginal bleeding. That is uterine bleeding and not tubal. Only 14 per cent of the cases in the Harlem Hospital series presented no vaginal bleeding.

Diagnostic Axiom: When a patient who is having sex life, presents herself with an anomalous menstrual period, ectopic pregnancy must be excluded before any other condition can be considered.

VI. Decidual Cast. The fact that the ovum is lodged in the tube does not prevent the uterus from preparing itself for the imbedding of the impregnated ovum. The uterus and the endometrium undergo all the typical changes one would expect in a normal intra-uterine pregnancy. This is due to the stimulation from the corpus luteum of pregnancy of the ovary. Should the ovum die or should it become separated from the wall of the tube for a sufficient length of time, the corpus luteum ceases to function, and with this loss of function there is a cessation of stimulation to the endometrium. When this stimulation ceases, the prepared decidua is cast off and discharged, either as a cast in one piece or several small pieces. *It is important to examine microscopically all tissue cast out of the uterus.* If the tissue cast out of the uterus shows decidual changes and no trophoblastic cells, a diagnosis of extra-uterine pregnancy must be seriously considered. It is only in those instances of a fundal imbedding, with a beginning abortion, and separation of the lowermost portion of the decidua without trophoblast, that an error can be made. All tissue discharged from the cervix should be examined microscopically. In this way a much higher percentage of decidual casts would be found.

VII. Pain (abdominal and shoulder). Tubal pregnancy causes no pain until hemorrhage takes place. The normally growing ovum in the tube does not cause pain. The tube can distend to accommodate this slow-growing ovum. But should hemorrhage occur with sudden marked distention of the tube, this increase in pressure on the tube wall causes pain. It might be dull and throbbing in character, or it might be colicky due to an attempt on the part of the tube to expel the ovum and blood.

In the luminal type of imbedding, with hemorrhage, the blood distal to the ovum is expressed into the peritoneal cavity

in small quantities. There is no rupture of the tube but the paroxysmal attacks of colicky pain are due to the periodic expulsion of blood from the fimbriated end of the tube into the peritoneal cavity. If the impregnation is near the middle of the tube and the blood from the fimbriated end is expressed slowly, adhesions form around it producing a pelvic mass.

If the onset of pain is sudden, sharp and severe, and the patient goes into collapse, it is usually due to a rupture of the tube in a mural or muro-luminal imbedding with a profuse hemorrhage into the peritoneal cavity. In this type of imbedding, the trophoblast eats its way into the wall of the tube, causing it to be very thin in places, and occasionally eroding the wall, but no symptoms develop at that time, as no blood is thrown into the peritoneal cavity. Should the trophoblast at the same time, or shortly thereafter, eat its way into the wall of a blood vessel and a slight hemorrhage take place, the blood will trickle through this (erosion) opening and cause slight colicky pain. However, should considerable bleeding take place, the thin tube wall is quickly torn wide open, rupture of the tube occurs, causing severe acute pain, profuse intraperitoneal hemorrhage and collapse.

These two types of pain are quite dissimilar and one should be able to make a differential diagnosis between a bleeding tubal pregnancy as against a ruptured tubal pregnancy. Occasionally the two types may overlap and be very hard to differentiate. In the series of ectopics studied, 65.2 per cent gave a history of sudden severe onset of pain, while 34.8 per cent described the pain as being gradual in onset. The closer the pregnancy was towards the fimbriated end of the tube, the more frequent was the onset of pain a gradual one.

Location and radiation of pain: Pain in the largest percentage of cases (75.4 per cent in the series) was confined to the lower abdomen, the site of the pain—right or left—depending on the involved tube. In only twenty-four cases (8 per cent) was there a radiation of the pain to the shoulder. Radiation of pain to the shoulder is due to a sub-diaphragmatic irritation caused by free blood under the diaphragm.

VIII. Syncope—Collapse. In the series studied, 64.8 per cent gave symptoms of syncope and 18.8 per cent gave symptoms of fainting. These symptoms combined were noted in 264 cases of 83.6 per cent in the series. Fainting or syncope are practically never noted unless there has been some intra-peritoneal hemorrhage. When the ovum or blood is slowly extruded from the fimbriated end of the tube, the patients may feel faint but they do not go into shock; it is when there is a rupture of the tube with sudden intra-peritoneal hemorrhage, that they go into shock or collapse. The hemorrhage in itself may not be of sufficient severity to cause collapse, but the sudden expulsion of a quantity of blood into the peritoneal cavity causes a marked irritation of the peritoneum with associated shock. The shock plus the hemorrhage give the symptoms of collapse. In these cases a mass is rarely felt. (See XVI.) Masses occur only when the bleeding is slow and the peritoneal structures can localize the blood.

IX. Anemia. This depends to a great extent on the pathology or type of ectopic present. If a tubal rupture due to muro-luminal or mural imbedding occurs with a tremendous peritoneal hemorrhage, the patient is in shock, she is pale, she has a low red blood count and she is anemic. In the unruptured luminal type of imbedding with a small amount of blood trickling from the fimbriated end of the tube, an anemia of any extent is usually not present.

Should the patient, however, have an old ectopic with a continuous small amount of hemorrhage from the fimbriated end of the tube into the peritoneal cavity, of one or two months' duration, associated with uterine bleeding, these patients may have a rather severe anemia. The average hemaglobin in the entire series was between 60 per cent and 70 per cent.

X. Abdominal Distention. This is a very frequent symptom that is overlooked; a moderate ileus develops reflexly as a result of blood in the peritoneal cavity.

Diagnostic Axiom: When a patient is seen with an anomalous menstrual period and a moderate ileus with distention, always think of ectopic.

XI. Pain on Defecation or on Motion of the Cervix or Uterus. This is due to the presence of blood in the peritoneal cavity causing an irritation of the pelvic peritoneum so that motion of any of these structures produces pain.

XII. Nausea and Vomiting. This is a very frequent symptom in the series. Almost one-half of the cases—133—gave symptoms of vomiting, and twenty-three patients complained of nausea. The nausea and vomiting probably were symptoms of the pregnancy per se and not directly due to the tubal pregnancy.

XIII. Temperature. As a rule the temperature is low, as blood in the peritoneal cavity does not cause any marked temperature reaction. However, in old ectopics where the localized blood masses have become infected, a rather high temperature may occur. The diagnosis of this condition, an infected old ectopic, is rather difficult.

XIV. Pulse Rate. This depends on the amount of blood the patient has lost. If she has lost very little blood, then there may be no rise in the pulse rate. Sudden, severe hemorrhage plus shock causes a rapid, thready pulse.

XV. Leucocytosis. The blood count may be of great help and it may occasionally make the diagnosis very difficult. Blood in a serous cavity always causes a leucocytosis. If the patient is seen soon after a fresh hemorrhage, there is usually a rise in the leucocytes and in the differential count. When the bleeding stops, the count goes down. If a blood count were taken every two hours, one would find the first polymorphonuclear count high, possibly 90 per cent, the second 85 or 80 per cent, and the third count may be as low as 75 per cent. With a second hemorrhage the polymorphonuclear count would again rise to 85 or 90 per cent. A sudden increase of the polymorphonuclear count with an increase of pain is always a sign of another hemorrhage. This rise in the white blood cell count is due to the irritation of the peritoneum (a serous cavity) by the fresh blood.

XVI. Masses in the Pelvis. In a ruptured ectopic, one may feel absolutely nothing in the patient's pelvis. If she has

a large hematocele, one may obtain the peculiar crepitation of clotted blood. Occasionally some clotted blood around the ovary gives the sensation of a mass.

In the luminal type of imbedding, with a *slow* hemorrhage from the fimbriated end of the tube, a mass may develop due to peritoneal adhesions forming around the clotted blood. When there is a slow leak for a long time, dense peritoneal adhesions form and as a result of continued small hemorrhages, the mass grows larger and harder.

No ectopic gives a mass unless there has been hemorrhage either within or without the tube. The pregnancy itself, except in the luminal type or in the secondary abdominal type, does not give a palpable mass. Occasionally, early in the luminal type, hemorrhage into the lumen of the tube may cause a palpable enlargement. Masses were found in 77.9 per cent of our cases: no masses were recorded in 17.5 per cent.

XVII. Blood Pressure. In the tubal abortion (luminal type of imbedding where there is, as a rule, no rupture of the tube with shock or hemorrhage) there is very little or no change in blood pressure. In tubal rupture cases there is a sudden drop in blood pressure due to shock and hemorrhage. The blood pressure may go down to zero. If the blood pressure of such a case is taken every half hour or every hour, one will find it will gradually rise until it reaches 90 or 100 and then another hemorrhage takes place and the pressure drops again. *Explanation:* The first drop in pressure is due to the shock caused by the sudden passage of a large amount of blood into the peritoneal cavity. Owing to the drop in pressure, the hemorrhage from the tube ceases and a blood clot forms in the rupture opening. When the bleeding stops, the blood pressure gradually rises until it reaches 90 or 100 mm. of Hg. at which time it is again high enough to blow out the clot and a secondary hemorrhage takes place. When this happens the blood pressure promptly drops again. To prevent this from occurring, these patients should be operated upon as soon as the diagnosis is made irrespective of the blood pressure. When indicated, the operation should be immediately followed by a transfusion. In the

delayed operation, one must sit at the bedside of the patient, wait for the pressure to rise, and operate before the secondary hemorrhage with accompanying drop in pressure can take place.

XVIII. Sedimentation Time. The sedimentation time is usually longer than thirty minutes. In only ten cases of the entire 313 studied was there found a sedimentation time of less than thirty minutes. Should the ectopic be an old infected one, a more rapid sedimentation time can be expected. The reason for the fairly rapid sedimentation time is probably hemorrhage.

Question: What is the value of the Ascheim-Zondek test in ectopic pregnancy?

Answer: In the acute ruptured ectopic, it is of no value because something must be done immediately. In the slow leaking tube, anomalous period, mass to the side of uterus, pain, no temperature, etc., one may wait for the result of the A-Z test. A positive test is a great help in diagnosis. A negative does not rule it out. It may only mean that the ovum is dead and the trophoblast no longer active.

Question: Is dilatation of the pupil on the side of the rupture a sign of ectopic pregnancy?

Answer: In our series this sign was of practically no value. This dilatation is probably due to a vagus reflex caused by irritation of the blood under the diaphragm.

Question: Of what value is Cullen's sign?

Answer: It is almost never seen. It is only seen in those cases where there is a large amount of blood in the peritoneal cavity. If the patient has an umbilical hernia, there may be some blueness in the hernia. When there is a large quantity of blood in the peritoneal cavity for several days, an area of blueness will appear around the umbilicus; this is Cullen's sign. It was seen only once in the entire series of cases.

Question: Of what value is the pyramidon test?

Answer: This test is used for the presence of hematin in the blood. It is a very good test if one can prevent the rupture of any of the red blood cells in the test tube, while the test is being done. A positive pyramidon test is due to the presence

of hematin in the serum from an old blood clot. But as positive results can be obtained by shaking the test tube and breaking up a few red blood cells, this test had to be discarded.

Question: What is the value of a cul-de-sac puncture for diagnosis?

Answer: The cul-de-sac puncture as a diagnostic procedure is not used routinely. As a therapeutic procedure it should be used in cases where there is an infected ectopic. These latter cases should all be drained extra-peritoneally, through the vagina if possible.

Question: Must all ectopics be operated upon?

Answer: No, many ectopics are never diagnosed and therefore never operated upon. Early in the pregnancy the hemorrhage may kill the ovum, forming a mole and the patient may never know she had an ectopic. Ectopic cases are usually operated upon for hemorrhage or pain.

Question: Of what value is a vaginal mucous membrane biopsy in the diagnosis?

Answer: Recent observers are attempting to diagnose pregnancy by changes in the epithelial layers of the vaginal mucosa. Up to the present, the number of cases observed is insufficient for any definite conclusions.

ROUTINE MANAGEMENT OF ECTOPIC PREGNANCY

On admission, a routine history; physical examination and laboratory work-up is done without the kidney function tests, blood chemistry or Wassermann. *All patients on whom a diagnosis of ectopic is made or suspected are typed for transfusion.*

Don'ts

1. Do not do a cul-de-sac puncture for diagnosis as a routine procedure.

2. Do not transfuse, infuse, or give a clysis, until the hemorrhage is controlled.

3. Do not present the history of the case to the Attending at the bedside. *On presenting the case to the Attending, give him the laboratory data and allow him to obtain his own history.*

4. Do not use Avertin basal anesthesia.

Avertin basal anesthesia is contraindicated in ectopic pregnancy. Secondary intra-abdominal hemorrhage may occur and may not be recognized due to the avertin anesthesia. It is also dangerous because of the respiratory depression in a patient who already has a reduction in the number of red blood cells. *Ether open cone* is the anesthetic of choice.

5. Do not give a transfusion with the patient under anesthesia. Reaction on the part of the patient to an incompatible blood is frequently missed if the patient is under anesthesia. Therefore, if a transfusion is to be given on the table before the operation is finished and while the patient is still under anesthesia, it is necessary to test the compatibility of the bloods by giving the patient 10 cc. of the donor's blood intravenously ten minutes before beginning the anesthesia.

6. Do not do an appendectomy on a patient with a ruptured ectopic. The patient is usually too sick to warrant the extra time required, and secondly the chances of infection are too great.

OPERATION

This is the one instance where speed is essential in a gynecological operation. On opening the peritoneal cavity, do not attempt to remove all the blood clots. The intestines should be walled off by laparotomy pads rather rapidly and the pregnant tube delivered into the wound as soon as possible so as to control the hemorrhage. As soon as the tube is delivered into the wound under tension, the hemorrhage stops. Once the hemorrhage is controlled, the tube and surrounding structures can be well walled off from the rest of the abdomen. If the patient is in severe shock, the infusion or transfusion can be started. *Do not start infusion or transfusion until hemorrhage is controlled.*

Operative Technique: Whenever possible clamp the mesosalpinx close to the tube and leave the ovary in situ. (For the technique of removing the tube see Chapter IV, pg. 90.) There is no reason why the ovary should be sacrificed in every ectopic.

In some patients where the opposite tube is not acutely inflamed and the patient is not in shock, the other tube may be resected to prevent an ectopic on that side. This, however, should only be done with the consent of the patient. *Never do an appendectomy at this time.* Do a one-point suspension of the uterus to prevent a postoperative retroflexion.

Some operators in order to aid in the delivery of the pregnant tube, place a double chromic suture through the fundus of the uterus on opening the abdomen. They use this suture as a traction stitch during the operation and later use the same suture for the one-point suspension. Ectopics should not be drained unless infected. Every case of ectopic pregnancy with a hemoglobin below 50 per cent should be transfused.

In abdominal or tubal pregnancies beyond the third month with a fully formed placenta, removal of the placenta may cause severe and even fatal hemorrhage. In these cases it is advisable to tie and cut the cord close to the placenta and leave the placenta in situ, closing the abdomen without drainage. The placenta is absorbed. It may take a long time, but ultimately it disappears.

[*To be continued in subsequent issues.*]

AUTHOR INDEX TO VOLUME XXXVII

Abbott, Walter D., 244
Atsatt, Rodney F., 291

Bellin, Harold, 306
Biegeleisen, H. I., 413
Bisgard, J. Dewey, 27
Bleyer, Leo F., 136
Bohrer, C. Dean, 466
Bottone, John J., 57
Browder, Jefferson, 4
Burke, Mead, 437
Burrows, Montrose T., 506
Butler, Paul T., 256

Chaffin, Rafe C., 239
Cherry, Thomas H., 302
Collins, Donald C., 440
Connell, Gregory F., 232
Corriero, William P., 341
Crile, George, 389
Crile, George Jr., 389

Davidson, Arthur J., 531
Duncan, George A., 112

Falk, Henry C. (S.), 149, 349, 549
Ferguson, L. Kraeer, 455
Findley, David, 518
Fowler, Samuel W., 403
Frost, John G., 319

Geckeler, Edwin O., 396
Goldberger, Harold A., 339
Gurney, Charles E., 297
Guy, Chester C., 319

Haines, Charles, 125
Halligan, Earl J., 493
Halligan, Harold J., 493
Harris, Franklin I., 263
Henson, Clifton W., 503
Horwitz, M. Thomas, 118, 531

Jacobs, J. E., 27
Jones, Randolph Jr., 446

Kaplan, Louis, 455
Kaplan, Theodore, 326
Katz, Abraham, 326
King, H. Jackson, 40
Kleinberg, Samuel, 418
Kocour, Elmer Joseph, 433

Lash, A. F., 68
Lippman, Robert K., 79

Mahoney, Louis E., 123
Martin, J. D., Jr., 511
Maynard, Aubrey de L., 92
McCormack, C. J., 205
Menefee, Elijah E., 446
Meyers, Russell, 4
Milliken, Robert A., 116

Nitschke, Paul H., 109

Page, R. C., 219
Pemberton, John, 205
Peterson, J. O., 530

Rankin, L. M., 219
Rathbun, N. P., 138
Rohde, M., 136
Ronchese, F., 475
Ross, Donald E., 498

Sands, Raymond, 123
Senger, Fedor L., 57
Service, W. C., 121
Stadiem, M. Lyon, 312
Stebbins, George G., 437
Stein, Herbert E., 528
Stenson, Walter, 334

Torpin, Richard, 343
Tsuzuki, Masao, 127
Tyvand, Raymond E., 132

Verbrugghen, A., 275

Waugh, Theodore R., 518
Weiss, David, 88
Whitaker, Lester R., 526
White, Alfred S., 263
White, Charles Ed., 135
White, J. William, 478
Wilson, Earl E., 470
Wolepor, Ben, 533
Woodbridge, P. D., 191
Woodruff, Stanley R., 484

Zener, F. B., 106

SUBJECT INDEX TO VOLUME XXXVII

(Bo.B.) = Bookshelf Browsing; (E.) = Editorial; (S.) = Serial

Absence of dorsal fixation of mesentery of small intestine, 511
Actual or bookkeeping maternal deaths? (E.), 189
Acute appendicitis: a comparative survey with remarks on its management, 40
Acute appendicitis: simulated by hemorrhage into hydatid of Morgagni, 106
Acute appendicitis in childhood, 446
Acute free perforation as first sign of regional enteritis, 493
Adenocarcinoma of the appendix: mucocele with peritoneal transplantation in, 518
Allergic, origin, hydroarthrosis of, 121
Ambulatory treatment for anal fissure, 88
American Board of Surgery organized (E.), 1
Anal fissure: ambulatory treatment for, 88
Anesthesia, metycaine spinal, 191
Appendicitis acute: a comparative survey with remarks on its management, 40
Appendicitis, acute: hemorrhage into hydatid of Morgagni simulating, 106
Appendicitis, etiology of, 232
Appendicitis, acute, in childhood, 446
Appendicitis: treatment of, 440
Appendix: mucocele with peritoneal transplantation in adenocarcinoma of the, 518
Axillary vein, thrombosis of the, 326

Biliary peritonitis without performation, 334
Biopsy needle, a new type, 341
Bladder and bowel conditions, presacral neurectomy in treatment of certain pelvis, 244
Böhler clavicular brace, a modified, 531
Book Reviews:
The management of obstetric difficulties (Titus), 146
Stedman's practical medical dictionary (Stedman), 146
Bones: a study of the development and structure of the vertebral skeleton (Murray), 146
Cosmetic dermatology (Goodman), 147
A synopsis of surgical anatomy (McGregor), 147
The Abraham Flexner lectures series number four.
Lectures on embolism and other surgical subjects (Nystrom), 148
The Physiology and pharmacology of the pituitary body (Van Dyke), 148
Urology for nurses (Lowsley-Kirwin), 346
Physical therapeutic methods in otolaryngology (Hollender), 346
A manual of radiological diagnosis for students and general practitioners (Tchaperoff), 346
Clinical roentgenology of the cardiovascular system, (Roesler), 347
Medical morals and manners (Royster), 347
Diseases of the newborn (Tow), 347
Inhalation anesthesia (Guedel), 347
The lung (Miller), 348
Operative surgery (Horsley-Bigger), 348
A woman surgeon: the life and work of Rosalie Slaughter Morton (Stokes), 543
Synopsis of anorectal diseases (Hirschman), 543
Christian R. Holmes: man and physician (Fischer), 543
The operations of surgery (Rowlands-Turner), 543
Cancer and diet: with facts and observations on related subjects (Hoffman), 544
Book Reviews:
Gastroscopy: the endoscopic study of gastric pathology (Schindler), 544
Surgical treatment, a practical treatise on the therapy of surgical diseases (Warbasse-Smyth), 545
Handbook of orthopedic surgery (Shands-Raney), 545
Preoperative and postoperative treatment (Mason), 545
Legal medicine and toxicology (Gonzales-Vance-Helpern), 546
Diseases of the nose and throat (Thomson-Negus), 546
Surgical pathology of the thyroid gland (Hertzler), 547
Recent advances in orthopedic surgery (Burns-Ellis), 547
Bookshelf Browsing:
John Hunter, 137
Sir James Mackenzie, the complete physician, 533
Bowel conditions: presacral neurectomy in treatment of certain pelvic bladder and, 244
Breast pump: mechanical, 135
Bursitis, 455

Cancer of rectum and colon, 437
Case of trigeminal neuralgia with osteitis of the wall of the infraorbital canal, 506
Catheterizing forceps; self-lubricating, 132
Cesarean section: instruments for low cervical operation, 343
Changes in infra-red photographs taken during the treatment of varicose veins, the, 470
Cholecystic and enteric spasm, surgical differentiation of, 503
Chronic dislocation of the elbow, 118
Clavicular brace, a modified Böhler, 531
Clinical gynecology, practical (S.), 149, 349, 549
Clinical osteomyelitis of long bones, 291
Colon and rectum, submucous lipomas of, 205
Colon: diverticulosis of the, 433
Colon: cancer of rectum and, 437
Congenital coxa vara occurring in identical twins, 112
Corkscrew-bolt for compression-fixation of femoral neck fractures, 79
Coxa vara: congenital, occurring in identical twins, 112
Cushing silver clip and clamp, a modified, 526

Device to facilitate surgical dressings, a, 339
Dislocation, chronic, of elbow, 118
Diverticula, esophageal, invagination operation for, 498
Diverticulosis of the colon, 433
Dorsal fixation of mesentery of small intestine: absence of, 511
Dressings, surgical, a device to facilitate, 339
Duodenal perforations, multiple, 319

Editorials:
Actual or bookkeeping maternal deaths?, 189
American Board of Surgery organized, 1
The future, 387
Elbow: chronic dislocation of, 118
Enteric spasm, and cholecystic: surgical differentiation of, 503

Enteritis, regional: acute free perforation as first sign of, 493
Epiphysis of lower end of femur, traumatic separation of, 306
Esophageal diverticula: invagination operation for, 498
Etiology of appendicitis, 232
Extradural hemorrhage, 275

Failures, recurrences and complications in injection treatment of hernia, 263
Fatty acid solutions for the injection treatment of hernia, two, 413
Femoral neck fractures: corkscrew-bolt for compression-fixation of, 79
Femur: traumatic separation of epiphysis of lower end of, 306
Filing system, a practical individual, 297
Fixation, subcutaneous, with screws for fractures of the hip, 396
Forceps, catheterizing: self-lubricating, 132
Fracture and orthopedic wrench, new, 530
Fractures of the hip: subcutaneous fixation with screws for, 396
Future, the (E.), 387

Genoscopolamine in obstetrics, 466
Grafting, skin: technique of, 92
Gumma of muscle, 125
Gynecology, practical clinical (S.), 149, 349, 549

Hemorrhage, extradural, 275
Hemorrhage into hydatid of Morgagni simulating acute appendicitis, 106
Hemorrhage, uncontrollable: of prostatic enlargement, 109
Hernia, injection treatment of, 256
Hernia; failures, recurrences and complications in injection treatment of, 263
Hernia: the status of research on the injection treatment of, 403
Hernia: two fatty acid solutions for the injection treatment of, 413
Hip: subcutaneous fixation with screws for fractures of the, 396
Hunter, John (Bo.B.), 138
Hydatid of Morgagni: hemorrhage into, simulating acute appendicitis, 106
Hydroarthrosis of allergic origin, 121
Hypernephroma, an ovarian, 312
Hyperparathyroidism, 27
Hyperthyroidism in children under five years of age, 389

Infections of the spinal epidural space: an aspect of vertebral osteomyelitis, 4
Infections of the urinary tract, 484
Infraorbital canal: a case of trigeminal neuralgia with osteitis of the wall of the, 506
Infra-red photographs taken during the treatment of varicose veins, the changes in, 470
Infra-red photography in the diagnosis of vascular tumors, 475
Injection treatment of hernia: failures, recurrences and complications in, 263
Injection treatment of hernia, 256
Injection treatment of hernia: the status of research on the, 403
Injection treatment of hernia: two fatty acid solutions for the, 413
Instruments for low cervical operation: cesarean section, 343
Intravenous therapy: a method pyrogen-free water for, 136
Invagination operation for esophageal diverticula, 498

John Hunter (Bo.B.), 138

Lipomas of colon and rectum, submucous, 205

Mackenzie, Sir James: the complete physician (Bo.B.), 533
Maternal deaths: actual or bookkeeping? (E.), 189
Mechanical Breast Pump, 135
Menopausal state, the, 302
Mesentery of small intestine: absence of dorsal fixation of, 511
Method for producing pyrogen-free water for intravenous therapy, 136
Metycaine spinal anesthesia, 191
Modified Böhler clavicular brace, 531
Modified Cushing silver clip and clamp, 526
Mucocele with peritoneal transplantation in adenocarcinoma of the appendix, 518
Multiple duodenal perforations, 319
Muscle, gumma of, 125

Neuralgia, trigeminal, with osteitis of the wall of the infraorbital canal: a case of, 506
Neurectomy, presacral, in treatment of certain pelvic, bladder and bowel conditions, 244
New fracture and orthopedic wrench, 530
New self-retaining retractor, 528
New type biopsy needle, a, 341

Obstetrics: genoscopolamine in, 466
Orthopedic and fracture wrench, new, 530
Os Subcalcis, 116
Osteitis of the wall of the infraorbital canal: a case of trigeminal neuralgia with, 506
Osteomyelitis, clinical, of long bones, 291
Osteomyelitis, vertebral or aspect of: infections of the spinal epidural space, 4
Ovarian hypernephroma, an, 312

Pelvic, bladder and bowel conditions: presacral neurectomy in treatment of, 244
Pelvis, renal: primary epithelial tumors of the, 57
Peptic ulcer, recurrent, perforating three times with recovery, 123
Perforations, multiple duodenal, 319
Perforation, acute free, as first sign of regional enteritis, 493
Peritoneal transplantation in adenocarcinoma of the appendix, mucocele with, 518
Peritonitis, biliary, without perforation, 334
Practical clinical gynecology (S.), 149, 349, 549
Practical individual filing system, a, 291
Presacral neurectomy in treatment of certain pelvic, bladder and bowel conditions, 244
Primary epithelial tumors of the renal pelvis, 57
Procidentia: a new operation for cure of fourth degree prolapse, 239
Prolapse, fourth degree, a new operation for cure of: procidentia, 239
Prostatic enlargement: uncontrollable hemorrhage of, 109
Puerperal sepsis: surgical treatment of the, 68
Pump, breast: a mechanical, 135
Pyrogen-free water: method for producing, for intravenous therapy, 136

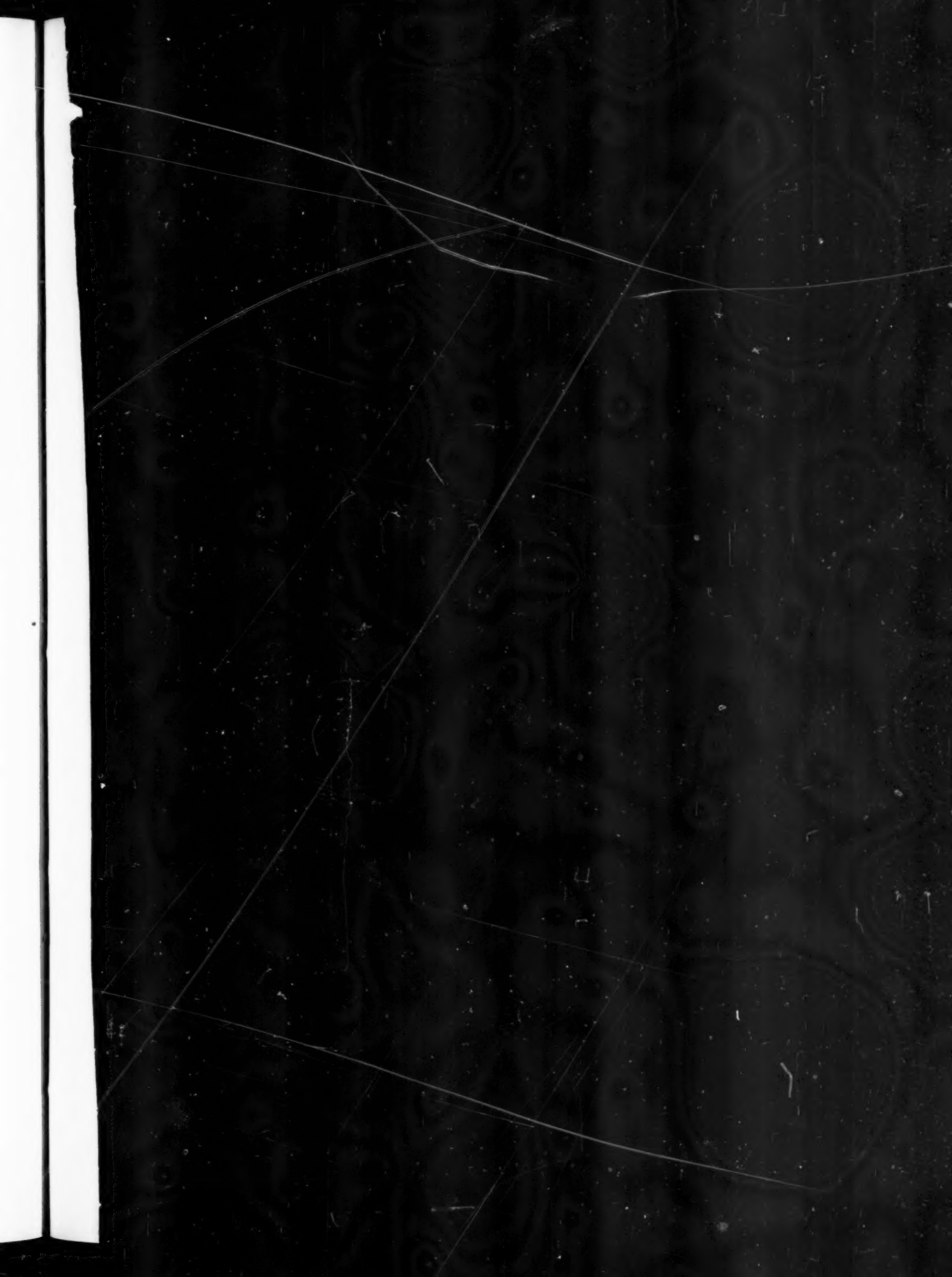
Ranula and syphilis, 127
Rectum: submucous lipomas of colon and, 205
Rectum and colon: cancer of, 437

Regional enteritis: acute free perforation as first sign of, 493
Renal pelvis: primary epithelial tumors of the, 57
Retractor, a new self-retaining, 528
Review of ulcer surgery at Presbyterian Hospital, 219

Sciatic scoliosis, 418
Scoliosis, sciatic, 418
Self-lubricating catheterizing forceps, 132
Sepsis, puerperal: surgical treatment of the, 68
Sir James Mackenzie, the complete physician (Bo.B.), 533
Skin grafting: technique of, 92
Spinal anesthesia, metycaine, 191
Spinal epidural space: infections of the: an aspect of vertebral osteomyelitis, 4
Status of research on the injection treatment of hernia, the, 403
Subcutaneous fixation with screws for fractures of the hip, 396
Subcalcis, os, 116
Submucous lipomas of colon and rectum, 205
Surgical differentiation of cholecystic and enteric spasm, 503
Surgical problems, 144, 344, 542
Surgical treatment of puerperal sepsis, 68
Syphilis: ranula and, 127

Technique of skin-grafting, 92
Thrombosis of the axillary vein, 326
Thyroid disease in the smaller hospital, 478
Traumatic separation of epiphysis of lower end of femur, 306
Treatment of appendicitis, 440
Trigeminal neuralgia with osteitis of the wall of the infraorbital canal, a case of, 506
Tumors: primary epithelial of the renal pelvis, 57
Two fatty acid solutions for the injection treatment of hernia, 413

Ulcer surgery, review of, at Presbyterian Hospital, 219
Ulcer: peptic, recurrent, perforating three times with recovery, 123
Uncontrollable hemorrhage of prostatic enlargement, 109
Urinary tract, infections of, 484

Varicose veins: the changes in infra-red photographs taken during the treatment of, 470
Vascular tumors: infra-red photography in the diagnosis of, 475
Vertebral osteomyelitis: an aspect of: infections of the spinal epidural space, 4

Wrench, new fracture and orthopedic, 530